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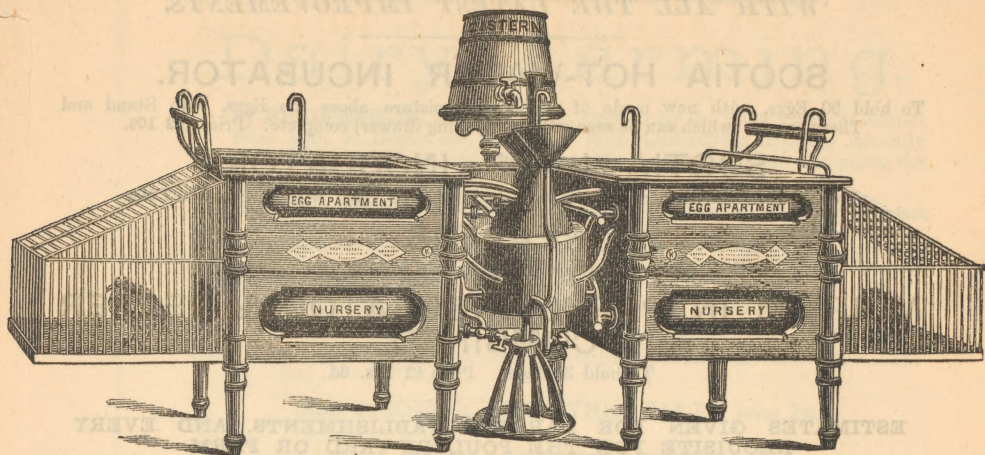
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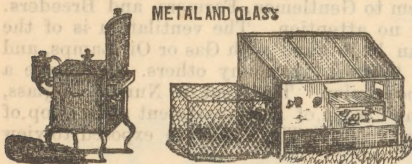
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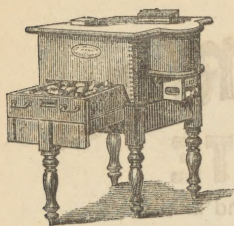
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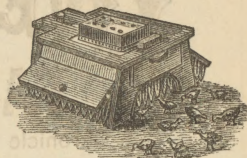


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PREFACE.

THE question of Artificial Incubation is daily becoming of greater interest to the English public, not so much from a curious or fancy point of view, but because foreign competition has compelled our farmers to turn their attention to things they once thought beneath them. Whilst corn, cattle, and dairy produce have fallen in price, until they are really unremunerative, poultry and eggs maintain their former prices, and upon all sides we find sure signs that what was once left to the farmer's wife as her perquisite is about to receive the attention it deserves, and will, we believe, become a recognised branch of the farming economy. Such being the case, Artificial Incubation must be looked at in a practical manner, and this is the reason for publishing this little work.

E. B.

October, 1879.

PREFACE TO THE SECOND EDITION.

THE favour with which "Practical Artificial Incubation" has been received calls for a Second Edition, and I have taken the opportunity of adding to it particulars as to the newest aspects of the question. That it has considerably advanced during the past twelve months is undoubted, as a reference to the columns of the *Live Stock Journal* during that period will prove; and not only have Incubators been more in use, but also they have been more successfully used than before.

E. B.

January, 1881.

Practical Artificial Incubation
53 #70 - Poultry & Eggs
Duck 53 #70

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CHAPTER I.

INTRODUCTION.

Various circumstances have brought the question of artificial incubation prominently forward, and at the present time both in America and France, as well as in our own country, very great interest is being shown in it. It is our desire to, as far as possible, give the present state of artificial incubation, and to offer some practical remarks upon it, intending to criticise the machines now upon the market, and in a friendly way to point out their special merits or faults, not merely as critic, but from personal experience.

It is quite unnecessary to tell the "old, old story" about the egg hatching in Egypt and China, as the accounts so often given of these have done more harm than good, for they have led people to imagine that the thing was to be done very easily, and they have gone into experiments, having neither the patience nor the time necessary for carrying them out, and the result has been a dismal failure. It is hardly necessary to remark that there are persons who have a "gift" for this art, as we may call it, just the same as all have gifts for some special pursuit. We know a young man who could and did hatch an average of ten out of every twelve eggs, and all he used was a small tin tank with a small lamp at the back, the whole not worth more than 5s, if all the labour spent upon it was reckoned up. He made the thing himself, and worked it as successfully as we have stated, without regulator, simply keeping the heat at its right temperature by turning up or down the wick as was needed. More than that, he did not sit by it day and night, but often left it for twelve hours untouched. He had "the knack," to use a northern phrase, and without that "knack," or a share of it, artificial incubation would be impossible to many.

The need of some means of hatching eggs without being troubled with the hens, has been felt by all who have kept fowls either for exhibition or profit. Who has not been bothered by getting plenty of eggs from the best birds, and been obliged to eat or keep them until they were spoiled, not being able to get a broody hen? Or, as we experienced it three or four years ago, been exasperated almost to madness by hens leaving their nests during a spell of extra cold weather, and having batch after batch of fertile eggs wasted? Or, again, have half a hatching sacrificed by the clumsiness of the hen just as the chicks were leaving the shell? In fact, the woes of a poultry keeper in the spring are beyond description, and, doubtless, are too painfully impressed on the minds of our readers to need recapitulation here. Few, we should think, have not wished for some machine that would do the work of hens and save this trouble and vexation.

The difficulties to be encountered in hatching artificially are apparently very few. Having heard of the wonderful egg ovens of Egypt, what appears

more simple to a new beginner in poultry keeping? The hens provide the eggs, and all they require is a certain amount of heat, a little moisture and *presto* the thing is done. The theory looks well, and in imagination all goes right, the experimenter can see in faith the chicks hatched and running about as lively as healthy chickens can be. We must digress here and say, we speak feelingly, as we were once overcome by this mania of theorising, and probably many others have been the same. At first all goes on right and smooth, the machine is made, lamp or gas is fixed, and the play begins. But—to skip over the sad intermediate details of difficulties in keeping the heat regular—the three weeks come to an end, and at the same time the fair dream or beautiful air castle comes to an end also. If the dreamer has patience, more trials will be made, and perhaps success after a while may come, but it only comes by experience. If he has not, the thing will be thrown up in disgust, and ever afterwards he will declare that “artificial incubation will never succeed,” nor will it in his hands, the truth being he was possessed of neither “knack” nor patience, two most necessary things in a study like this. We feel certain that many of those who denounce “artificial incubators” so strongly, are those who have neither of these gifts. Of course, if a machine was bought instead of made, the tale is all the more dreadful.

There are one or two considerations which ought to be discussed before anyone either makes or purchases an incubator, for machines of this nature need careful and patient attention. No incubator can be purely an automatic machine, or one that does the work in a swift or sudden manner. Many persons seem to think that incubators work by magic, that is, put the eggs in at the top, turn a handle and the chickens appear, or put the eggs in at night and have them hatched the next morning. We have often found considerable amusement in listening to remarks made by people, when a machine has been shown them. A question of the attendant, asked by very many, is, “How long do they take to hatch?” and many seem to think that it is a waste of time and energy if it does not hatch the eggs any quicker than a hen.

One of the first considerations which should be thought of, is, whether sufficient time can be given to it. When chickens are coming out they need attention, and if artificially hatched many little things require to be done for them, which naturally are done by the hen. At other times, the machines need very little attention, but when hatching, especially when there are a number coming out, it is quite different. And it is a thing that cannot be left to a servant, unless that servant takes as much interest in the matter as the master, there being many little things which might be thought of no consequence and neglected. Of course, if poultry breeding is worked upon a proper basis, and a number of incubators are kept, it will be necessary to have a man to devote his time principally to the care of them, and, in that case, no man would be kept unless he could work the machines successfully. The second consideration is, can a suitable place be given up for the purpose. We remember seeing in the *Live Stock Journal* some advice to intending purchasers of incubators, written by Mr Wren, we think, to the effect that if you have not got a suitable place to put it, don't buy one, and this advice we would strongly urge. What is required is a place free from draught, of moderate temperature, and secure from interference. An old out-house or tumble down hen-house won't do. A conservatory or a spare room is best, but much depends upon the kind of machine. For instance, whilst a lamp machine would always make its presence unpleasantly known in a house, and a gas machine also, only in a less

degree, a hydro-incubator would not be at all unpleasant, even if placed in a sitting-room. Therefore, gas or lamp machines are better placed either at the top of the house or in a suitable out-house.

The next question that will naturally arise—supposing the purchase of a machine is decided upon—is, which of the machines upon the market shall be got, and we will endeavour in the next and following chapters to describe each of the machines, to enable the intending purchaser to decide which he will try.



CHAPTER II.

BOYLE'S MACHINE.

One of the greatest difficulties that experimentalists in artificial incubation have met with has been in the regulation of heat, and until very recently it was thought that if the heat could be kept even, the whole thing was done. We first propose to give some account of the machines upon the market, which, being heated by lamps or gas, have some method of regulation so as to obtain an even temperature. It is not necessary for our purpose to go back any length of time, in order to enquire into the machines which have been introduced, and then allowed to pass into oblivion, for our object is to give an account of those machines only which are now being offered to the public. We regret being unable to speak of the American incubators, especially as we have received such good reports of them; but as we are not aware of any having been brought into this country we have had no opportunity of seeing them.

The first machine we will speak of, is that invented by Mr Henry Boyle of Ambleside, and for the regulator of which he holds a patent. Mr Boyle lives at Eller How, overlooking Windermere, and we shall ever remember with the keenest pleasure, three delightful hours spent with him there, the view from his grounds being one of the grandest we ever have seen. Mr Boyle is not a poultry fancier, but is passionately enamoured of rare and beautiful plants, and in his fernery we saw what can be seen in few of the largest in England. We believe that the regulator was invented by him for his orchid case, and it was not for some time after he had perfected it for that purpose, it was suggested as the very thing required for an incubator, and his attention was thus turned to what has been, we fear, a costly study.

The Boyle Incubator is about 2 feet square and 3 feet high, having at each side a shelf, with small mothers for the chickens. A door, occupying about half the entire front, on being opened displays the working apparatus, which consists of a boiler, under which room is given for the placing of the lamp or gas burner, and in front of it is fixed the regulator. Above this door are two smaller doors which open and form a slide, upon which the egg tray can rest when drawn out. These latter serve a double purpose, being in the first place the means of getting to the hatching box, which is simply a circular tray with 2 inch sides, and covered with a piece of perforated wood, in which the eggs are placed, wrapped in flannel as soon as they are chipped. About this hatching box we shall have more to say presently. The doors, when opened, show the bottoms of the eggs in the egg tray, and are also used for regulating the temperature at the bottom of the eggs, which is done by closing or opening them.

Fig. 1 is the Boyle machine as first made, but several alterations have since been introduced. The hatching box is here shown on the top of the machine, but now it is placed on the top of the boiler beneath the egg drawer. This, we think, is an improvement, but we think the wisdom of the arches, under which the eggs slide, in place of the plan portrayed in the illustration, is very questionable. The egg tray is a perforated tray made of tin, the holes in which are about the size of an egg, but to prevent the eggs falling through, narrow strips of tin are fixed, so that the eggs are about half above and half below the tray. Upon the tray small metal cups are placed, and being kept filled with water, charge the air in the egg drawer with moisture. Above the drawer are a series of arches, under which the eggs slide, the object being to make the heat above the eggs as even as possible. The whole machine presents a neat appearance, and is finished in a first-class manner.

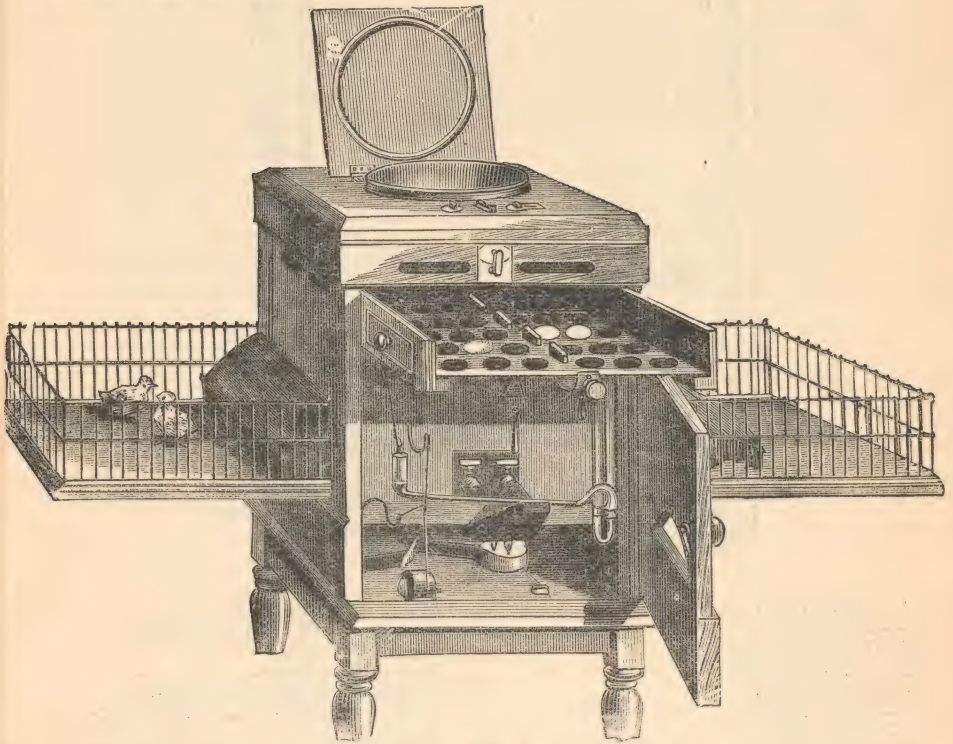


Fig. 1.

The most important and valuable part of the machine is the regulator, description of which we will now give.—(Fig 2.)

The regulator works by the expansion of water (which is much greater than that of mercury) and the weight of mercury. When the boiler is filled with water, and heated to the proper temperature, mercury is poured into the bowl F until it rises sufficiently high in the tube E. This tube being connected by the india-rubber tube D, with the boiler, and the water in the boiler having no other outlet, when the heat rises and the water consequently expands, the mercury is forced into the bowl, and (B being the balance lever, I the pivot gas tap, H the balance weight) relieves the balance weight, and reduces the supply of gas. If the heat falls, the water in the boiler contracts, and allows a portion of the mercury to fall back into

tube E, and consequently increases the gas flame. The springs are to prevent the bowl rising and falling too suddenly. With oil a circular lamp is used, which works on a central pivot, and is so constructed, that, by means of a thread hooked on to bowl F, and a counter-acting spring fastened to the lamp, a greater or smaller amount of flame is exposed, according to the temperature required.

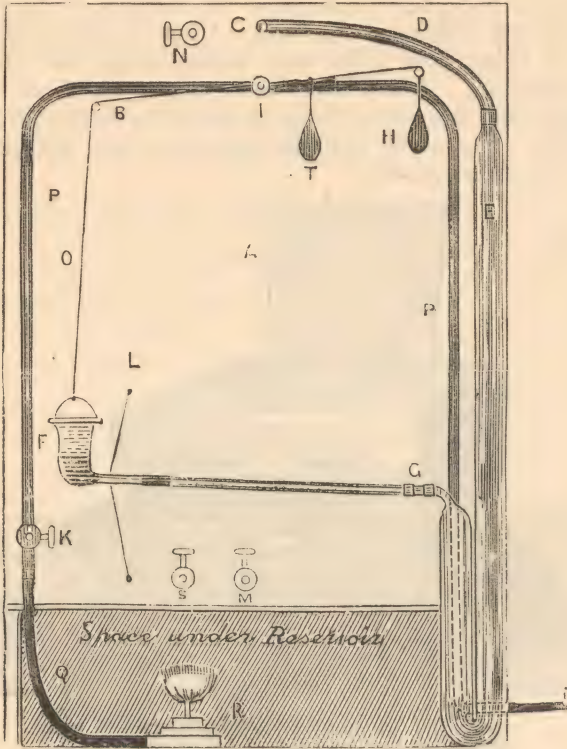


Fig. 2.

A—Front of box.
B—Balance of lever.
C—Connecting pipe.
D—India-rubber pipe
E—Glass U tube.
F—Bowl for Mercury.
G—Elastic joint.
H—Balance joint.
I—Pivot gas-tap.
K—Stop tap (gas).

L—Compensating spring.
M—Tap of boiler and supply pipe.
N—Air-tap boiler.
O—Connecting wire.
P—Connection with gas supply.
Q—India-rubber connection with flame.
R—Gas lamp.
S—Tap for letting water out the jacket.
T—Additionable moveable weight.

This regulator works with the greatest nicety, and is never failing in its action. It could be left for a week without needing attention if it was set at the right temperature. We have known it work for a month with every kind of weather during that period, and the egg drawer not vary above 3 or 4 degrees, whilst the regulator will not vary half a degree. In fact, we do not know of any regulator—excepting an electric one—which we dare leave with the same confidence for any length of time. We have done some very good work, indeed, with it, hatching as far as 80 per cent. of eggs placed in it, *i.e.* leaving out the unfertile and *broken* ones. We have italicized the word broken, because we wish to call special attention to what we must consider one of the defects of the machine.

There is one thing which has worked against the success of this machine, and that is the price, considering the few eggs it holds. The egg drawer is only perforated for 42 eggs, and as the price is about £15 15s, only those in command of plenty of money could afford to purchase one. We do not say for one moment that it is too high in price considering the work there must be in the making of it, but few people care to spend so much for, what is to them, a thing of doubtful success.

The qualities which must ever recommend this machine, are its compact form and its almost, nay perfect, regulator. There are several improvements which could easily be made in it. To our mind the greatest defect is the egg drawer, which is both complicated and useless. If, instead of having a tray such as it now has, it had perforated zinc, the object for which the tray is so made, namely, the keeping cool of the bottom of the eggs, would be gained. The arches under which the tray slides are also useless, and the cause of very great annoyance and vexation. We have had scores of eggs in various stages broken by these arches, and often have been exasperated almost to frenzy by seeing eggs with lively and healthy chicks in them, within a day or two of hatching, broken in this way, and it could not be attributed to carelessness, for if an egg was a large one, it was scarcely possible to keep it whole to the end. The hatching box is not by any means perfect, and we think the substitution of an under heat for the top heat, after the egg has chipped, tends to cramp in the chicken's legs, and to prevent weakly chicks from hatching out at all. If the egg drawer was altered, as we have suggested, there would be no need whatever for a hatching box, as a piece of flannel might be thrown over the eggs as soon as they were chipped, and would answer all the purposes required. We would also advise the keeping of a dish of water on the top of the boiler below the egg drawer, to keep the air moist. We think 102 degrees over heat, and 99 degrees under heat, the best for successful hatching with this machine.



CHAPTER III.

PENMAN'S PATENT INCUBATOR.

The incubator we are about to describe was first introduced to the public two years ago, being the invention of a gentleman resident in Newcastle-upon-Tyne, who has studied the question many years, and been most successful in hatching. It won the silver medal at the Dairy Show in October, 1877, for the best incubator in action, but at the Hemel Hempstead tournament in 1878 neither of the machines sent there succeeded in hatching a single chick, although the day after the competition was over a large number of live birds were found in the eggs.

The following is the description of the principle of the machine as taken from the prospectus:—

“It appears that every failure (in Artificial Incubation) must be attributed to attempts made to improve upon nature, instead of imitating her wonderful workings. In the case of the egg she has ordained the germ (so long as it is kept in a horizontal position) to float uppermost within and against the shell, in order that it may meet the genial warmth of the breast of the fowl. We must, therefore, in incubation, apply warmth to that part only, and of the degree determined by Nature. A fowl of any kind prefers to incubate upon the ground. Nature having supplied the egg with only a limited quantity of moisture, has thus arranged to prevent evaporation from a large surface, as the egg is only warm at the point in contact with the fowl, until the blood vessels, searching for nourishment for the embryo, have surrounded the inner surface of the shell, when the whole egg becomes gradually warm, and eventually of an equal temperature by means of the circulation of the blood through these vessels. We must, in a word, apply the same degree of heat as Nature, and in the same manner—‘by top-contact’; and, like her, allow the interior portion of the egg to remain cool, until warmed by the inward circulation of the blood. The difference between ‘top-contact heat’ and that received from ‘radiation,’ as applied to hatching, is this: by radiation, or oven heat, the eggs will be hours arriving at the desired temperature, not only when first put to hatch, but at every time afterwards when they have been allowed to get cool. The egg will, of course, heat alike over its whole surface, and, consequently, evaporate equally from every part. On the contrary, heat applied in ‘top-contact,’ penetrates almost instantly and revivifies the germ.

“To carry out this principle, so intelligently given in the above paragraph, Mr Cantelo, about 30 years ago, after many experiments and much consideration, found that the best way of applying the ‘top-contact heat’ to eggs during incubation was by a current of water flowing over an impermeable or waterproof cloth, beneath which the eggs are placed;” and it is

a pity that in the article from which the above extract is taken no reference is made to the success which he achieved.

"In constructing the Incubator now brought before the public, the above principle has been constantly kept in view, and strictly carried out; for there is no radiating or oven heat maintained, and no egg will be hatched in it that is not brought into top-contact with the source of heat."

Upon the face of the matter it will be seen that this machine, in respect to contact, is the only one which follows Nature, and there is no doubt but that the principle is a correct one, as the only heat received by an egg from the hen is certainly where she touches it. The difficulty which Cantelo experienced was, that the waterproof cloth began to bag because of the weight of water, and this, when it did so to a great extent, crushed the eggs in the process of hatching, or smothered the chickens as they were hatched. He was obliged eventually to give up the cloth, and substituted glass for it. But his machine, like many others, from some cause or another, passed into oblivion, and only the older generation of fanciers have any remembrance of it.

Mr Penman, in his experiments, found that India-rubber was the best thing he could find for his purpose, and in spite of many objections which have been made to it, he has proved that, if properly washed before being used, all objectionable smell arising from the sulphur is taken away. But even India-rubber in time bags considerably.

This incubator is made in three sizes, for 50, 100, and 200 eggs respectively, the latter being the size first made. The two larger sizes we have been very successful with, the smaller one we have never tried ourselves, although others have, but with very varying results.

The machine—we are describing the medium one—is oblong in shape, and about 30 inches high, having the appearance of a wooden frame. In the front are seen the two trays covering the water compartment, the thermometer, the egg trays, and the mother and run; the boiler, regulator, and lamp or gas jet, being fixed at the back. On removing one of the trays, the India-rubber sheet, the water, and the regulation pipes immersed in the water are exposed, and the shape of the eggs, on which the rubber is lying, can be seen. The rubber is fixed into a wooden frame, and exactly midway three holes are placed, connected with a metal tube, through which the water comes after being heated in the boiler. At each end are two holes, connected with pipes, which carries the cooler water to the mother, after which it passes to the boiler to be re-heated, so that a constant circulation is taking place. Upon the under side of this frame are fixed the egg trays, which are held in position by a wire pin and a hook. These trays are made of zinc, with two rows of holes for the admission of air both above and below the eggs. A smaller tray is fixed inside, made of perforated zinc, beneath which damp soil is placed to give the necessary moisture. The regulator is a very ingenious contrivance, and can be made to work very effectually. For lamp it consists of a pill box shaped brass vessel, upon one side of which is placed a flexible diaphragm, which, being connected by a fine rod to a slide cut V shape, reduces the flame of the wick if pressed over it, or if drawn back from it allows more flame to appear. In the gas machine there are two brass vessels, one of which is worked in the same manner as for lamp, but the rod is connected with the diaphragm of the opposite vessel, on the inner side of which a fine brass pin is fixed, and which, when pressed in, exactly fits into a fine hole, and reduces the supply of gas (admitted by a pipe on the top) to the burner. In both

instances the regulating power is water or spirit, enclosed in the tubes mentioned as being seen when the tray was removed, which, having no outlet, and being connected with the first-named brass vessel by a small pipe, when the water expands or contracts by the rising or falling of the heat, moves the diaphragm, and this acts as the regulator. It is necessary, however, to have four, or at least three of these regulation pipes, to give a sufficient body of water or it will not be susceptible enough. We think this was the secret of the failure of this incubator at Hemel Hempstead last year, as the machines sent there had only two tubes, and, as a consequence, the temperature was very variable. In our own experiments, we have found the same thing occur, when there were only two tubes for regulation.

The merits of this machine are, the capital arrangements for giving the necessary moisture, and the eggs being heated by actual contact. We think an improvement might be made in the fixing of the India-rubber, as it bags very considerably after being used for a season. This could be done by fixing rods of wire below it at intervals, but there would have to be corresponding partitions in the egg trays, to prevent the eggs from touching and being broken by these wires. It would also be an advantage to do away with the mother altogether, as it is too boxed up, or to make it more open, and to close in the sides and front of the machine, as the egg trays are too much exposed, for in very cold weather the eggs are chilled when against the sides of the trays. If these improvements were made, and four tubes used for the regulator, it would be a very good and useful machine.

We ourselves have, as we stated at the outset, worked this machine very successfully, but not when it had only two tubes. We have had it at work for several weeks keeping a very even temperature, and hatched a goodly percentage of chicks, and we know several who have done the same. Its success at the autumn show of the Northumberland Agricultural Society and the Dairy Show held at Islington, London, in 1877, were severe tests, for at the latter eggs were taken in process of incubation from Newcastle to London, and there hatched in the Agricultural Hall. In conclusion, we may say that for a perfect regulating and working incubator, we should think Boyle's regulator and Penman's incubator would be unequalled.

(See appendix A.)

CHAPTER IV.

CASHMORE'S INCUBATOR

Some readers may probably never have heard of this machine, which is the invention of Mr Cashmore, of Loughborough, and, being sold at a very low price for a lamp machine, it may be thought to be a toy and nothing more. Such, however, is not the case, as with ordinary care and attention it will be found very useful and handy for any one who wishes to hatch only a very few birds at one time. Fig. 3 is an illustration of it, and will now describe the method of working.

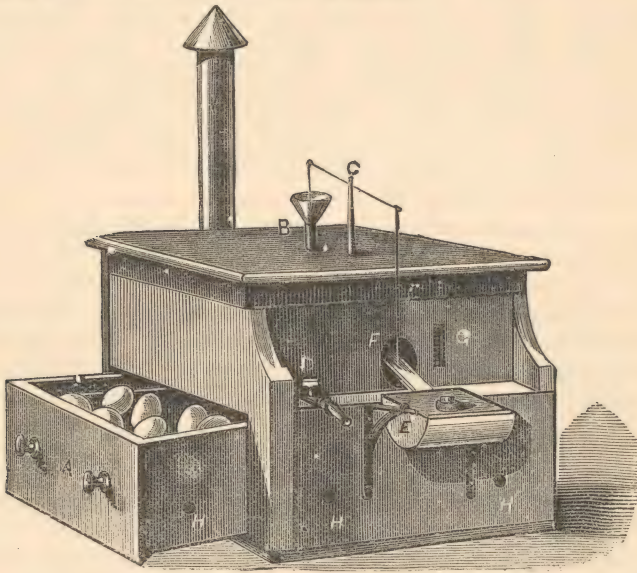


Fig. 3.

This machine stood second in the trial of Incubators at Hemel Hempstead in September last. The record of its work there will be found in Appendix E, which is the report of the committee upon that trial.

The machine is about 2 feet square and 18 inches high. At the front is shown the egg drawer, A, holding about 50 ordinary sized eggs, which are placed upon flannel over a sheet of perforated zinc. The moisture is given from a tray not shown, which is filled with earth and kept moist, as in the Penman and Christy machines, but with the difference that it is much larger, and consequently is capable of giving off more moisture; this tray is only seen when the egg drawer is taken completely out. The inlet to the tank is at the funnel, B, which is also used for the regulator, and which we will describe presently; C is the pivot for the regulator rod; D is the exhaust pipe; E is the lamp (for Benzoline), carefully balanced upon the two brackets shown in the plate; F is a tube which runs to the

chimney I, and in which the burner is placed ; G is the thermometer ; and H are the holes for the admission of air to the eggs.

The method of working is as follows :—Hot water is poured into the funnel B until it is filled, when the machine is allowed to cool down until it comes to the requisite temperature, when the lamp is lit and fixed in position. The wire from the rod is then hooked on to the lamp, and at the other end of this rod a hollow weight is hung, which, being just balanced by the lamp, floats on the oil which is placed above the water in the funnel to prevent evaporation. Within the tube F about the quarter of an inch beyond the end of the burner, and below it, a brass tongue is placed of a wide  shape inverted, and this forms the principal part of the regulator. The result is, if the machine gets hotter than the temperature at which it is set, the water in the tank naturally expands, and, having no other outlet than the funnel B, rises there, in consequence of which the weight is raised and the burner falls, cutting off nearly all the flame, and, of course, as soon as the temperature falls again, the water contracts, the weight is lowered, the burner rises, and the flame attains its full size. We found, when testing this machine, that it kept its heat very even indeed, and with as much regularity as any lamp machine we have yet tried. But we must confess that we do not like lamp machines ; first, for the attention they require, and second, because of their smell ; in this one, however, the last objection need not be thought of, as it gave forth no smell whatever, but perhaps this was partially due to the fact that we fixed its chimney in the fire place of the room, and any smell would go up there.

Considering the small size of the machine, it is wonderful how regular the heat is kept, but this is partially due to the fact that the bottom body of water is not interfered with, as the lamp heats only the upper portion. This we think a good plan, and which can be used in the gas or lamp heating machines, as well as in Hydro-Incubators. The small size and consequent cheapness is an advantage to many, who do not care to have a large and cumbersome machine, but one that they can handle easily.

Mr Cashmore has applied a gas regulating apparatus to his machine, but we have had no experience of it. It, however, failed at Hemel Hempstead, but through no fault of the machine, as it was due to some irregularity in the supply of gas.

The merits of this Incubator are its size, the simplicity of its working, its capital regulator (of which we will say more directly), its excellent arrangements for air and moisture, and the small cost for the oil it burns. Its only demerit is that the regulator will only regulate within a certain number of degrees. Our remark requires some fuller explanation to show what we mean, and it is this—that in a sudden change of temperature from, say, 50 deg. to 30 deg., the flame being full for the former, would, of itself, not be able to meet this, and the heat of the machine would go down in consequence. Again, if sudden heat came, raising the temperature of the atmosphere 20 deg., it would greatly interfere with the heat of the machine. This is, however, a matter that can always be avoided by extra attention when such occurrences take place, and is just what may be looked for in other machines more pretentious than this one. It might, also, be entirely obviated if the tongue was of this shape , as it would then have more regulating power. Of course, this is a suggestion merely, and we would advise Mr Cashmore to try it on his excellent machine.

(See appendix B.)

CHAPTER V.

WATSON'S "SCOTIA" INCUBATOR.

This machine was in the unfortunate position of being last in the Hemel Hempstead trial of Incubators in September this year, although worked by the inventor himself, Mr. James Watson, Montgreenan, Kilwinning, Ayrshire, N.B. It is altogether on a different principle to any other machine, being worked by lamps, but has no regulator whatever.

In appearance it is like a very flat box with one drawer in front, and an arched hole at each end of it. It is about 3 feet in length, half that width, and 15 inches in height, the outer case being wood entirely. A tank about $1\frac{1}{2}$ inches deep is fitted in it extending the whole length of the machine, holding the water, which is heated by the lamps placed in compartments of which the arched holes are the entrances. These lamps are simply ordinary paraffine lamps with the usual burners, but of course without a chimney. Above these the metal is bright, and the heat arising from the flame, which can be turned sufficiently low as not to smoke, can easily heat the water in the tank. The egg drawer is placed between the two lamp compartments, and is sufficiently large to hold 100 eggs. In the bottom of this drawer grass sods are placed, or earth, if that be more easily obtained, and kept constantly moist; above this a layer of straw is laid, on which the eggs are put. Ventilation is given over the ends and back of this drawer.

The record of its work at Hemel Hempstead will be found in appendix E, but we think it fair to the inventor to say, that greater success would have been attained by it, had it not been for the trouble he had with the regulation of the heat during the first few days of the trial.

We see no reason whatever why this machine should not succeed, if kept in a proper place. It is natural to suppose that it will require more attention than either a regulating or a hot water machine, as in one there is some way of keeping the heat fairly even by means of a regulator, and in the other by the great body of water, but if kept in a room where the temperature is pretty even, we should not despair of hatching with it. Whilst believing that a few degrees variation will do no great harm, so long as the heat is not allowed to rise too much, we certainly think that the steadier the heat can be kept the better, and there is a danger now of neglecting the old desire for uniform heat, and flying to the other extreme, which must have its due attention.

The great fault in this machine is the defective ventilation. It is unwise to expect that the fresh air will run up one side, travelling over all sorts of odd corners, and finding its exit in the same manner. Some better provision ought certainly to be made, as this is one of the most important points to be attended to in all Incubators, and without it, success will be ever uncertain.

The "Scotia" machine is very reasonable in price, costing only £2 10s. for a 100 egg machine.

CHAPTER VI.

CHRISTY'S HYDRO-INCUBATOR.

We must, at the outset of our remarks upon this machine, confess to having had at first a very strong prejudice against it. We first saw it at the Dairy Show of 1877, and from the fact that it was altogether against the current notions of what an incubator ought to be, being worked in a manner that appeared ridiculous, and that the attendant upon it there knew little or nothing about the actual working, we conceived the idea that it was a toy, suitable only for those who desired to play at artificial incubation, but of no use for practical purposes. In consequence we held it in a sort of contempt, and, until the September of 1878, this idea remained fixed in our mind, but it was then rather rudely removed by the result of the tournament of Incubators at Hemel Hempstead. It is not our desire or intention to say anything about that trial, more than it affects the machine which we are about to criticise, at which it came off with flying honours, winning the prize easily. But the fact that it hatched such a large proportion of the eggs was astounding to us, and, had any of the other competing machines actually won by hatching a still larger number, the ideas we had would still have been dispelled, and we would have been equally compelled to acknowledge that we had been all wrong. Had the percentage been small, we would have thought that the hatching had taken place *in spite* of the machine, as there are eggs that will hatch almost anywhere, but, when the percentage was 75, this could not be the case.

As will be seen from appendix this machine has this year at Hemel Hempstead maintained the position it won the previous one, and far exceeded the percentage then recorded. It is very remarkable, indeed, that at a trial of this kind no less than 97.18 per cent. of fertile eggs should be successfully hatched, and this result will doubtless place this incubator in an almost unassailable position. The machine thus succeeding was a 100 egg machine, but it is puzzling in the extreme that the other Christy, an 80 egg machine, in the trial should be fourth, having only hatched 43.33 per cent. Of course, no one can account for this remarkable difference, and it will have to remain an undecided matter; sufficient it is, that one apparatus should do its work so effectually.

This machine is the invention of Mr. Thomas Christy, 155, Fenchurch, Street, London, and we believe, so far as the mode of working is concerned, he obtained his idea from the Rouillier Incubator used so much in France. He has made several alterations, which he considers improvements, but as we have not yet had an opportunity of testing the Rouillier, we cannot express an opinion upon them. The machine is about 30 inches square, and outwardly has an appearance of a wood chest with a drawer at the bottom and a glass gauge above; in fact, it has very little appearance of being an incubator from its outward aspect, having none of the mechanical contrivances that are generally to be seen on these machines. (See fig. 4.) It is simply a tank occupying two-thirds of the whole, the remaining third

being taken up with the egg drawer. This tank has some internal compartments which divide the water, the object of which will shortly be seen. The inlet to the tank is on the top, and the outlets, of which there are two, are at the front. One of these is about half-way down, the other being fixed at the bottom of the tank. The gauge glass, of course, registers the height of the water in the tank. A wooden door, on being removed, reveals the egg drawer, which, on being drawn out, shows the thermometer, and the arrangements for moisture. The eggs are placed upon a perforated zinc tray, the holes allowing the moisture to rise from the earth trays beneath, and keeping the bottoms of the eggs cool. Air is admitted by two rows of holes at each side of the machine, one row of which admits air into the drawer above the eggs, and the other below the eggs.

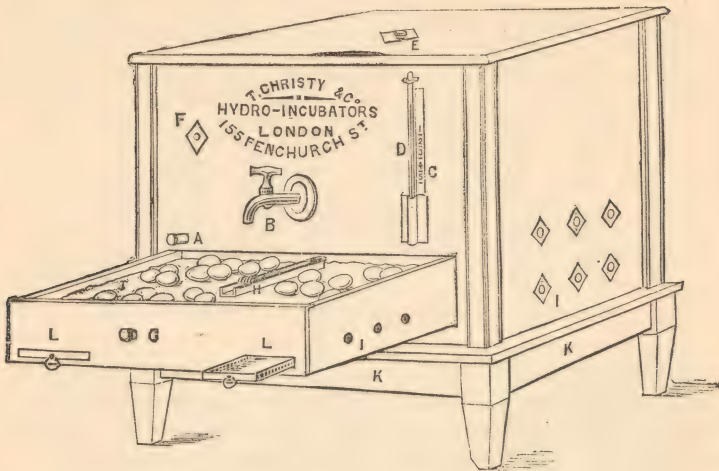


Fig. 4.

HYDRO-INCUBATOR FOR 100 EGGS.

A is the pipe only used for completely emptying the cistern ; B, the brass tap for drawing off the water prior to replenishing the cistern with boiling water ; C, the glass gauge with a marked scale, D, at the side to register height of the water in the cistern ; E, the pipe for filling the cistern ; F, the tube for escape of air when water is put in the cistern ; G, the drawer into the front of which the new earth-trays slide ; H, thermometer in the drawer ; I, I, the air-holes in sides of incubator and drawer ; J, the flannel ; K, the stand or box used to keep the incubator off the ground ; L, the earth-trays.

The marvellous part of the whole thing is, that it works without lamps or gas, and, therefore, needs no regulator, which is always the most expensive and difficult part of a self-regulating incubator. The mode of procedure is to fill the machine with boiling water, which raises the heat up to about 120 or 130 degs., and after allowing it to cool down to 102 degs., keep the heat at about that temperature by drawing off every twelve hours, by the tap placed midway in the tank, a sufficient quantity of water, and replacing it by the same quantity of boiling water. Strange though this may seem, if it is properly done it will keep the temperature pretty even. The quantity requiring to be taken out varies with the outer temperature, and whilst a very small quantity of water will work it in summer, or if kept in a warm room in winter, if kept in a cold place it takes a large quantity to keep it going. Below, we give tables from our experiments of the heat of the machine and the quantity of water required to work it.

TABLE A.—DECEMBER, 1878.

Day.	Heat of Room.			Heat in drawer.		Water taken out. *		Quantity of Water.	
	10.am.	10.pm.	Min.	10.am.	10.pm.	10a.m.	10.pm.	10a.m.	10p.m.
	Degs.	Degs.	Degs.	Degs.	Degs.	Degs.	Degs.	Gals.	Gals.
24	43½	56	40	102	103	146	149	6½	6½
25	44½	44	34	100½	101	145	150	6½	6½
26	45	56	40	101	102	145	147	6½	6½
27	52	58	42	102½	104	144½	150	6½	6
28	50	56	46	101½	1042	144	150	6½	5
29	50	50	45	102½	104	141	148	6½	4
30	50	58	45	102½	105	145	146	6	5½

TABLE B.—MARCH, 1879.

Day.	Heat of Room.			Heat in drawer.		Water taken out. *		Quantity of Water.	
	10.am.	10.pm.	Min.	10.am.	10.pm.	10.am.	10.pm.	10.am.	10.pm.
	Degs.	Degs.	Degs.	Degs.	Degs.	Degs.	Degs.	Gals.	Gals.
4	60	64	58	105	103½	142	140	3	4½
5	62	60	54	104	103½	137	138	3½	4½
6	64	62	52	103	103½	138	138	3½	3
7	64	62	53	102	103½	132	138	4½	4
8	59	65	52	105	105	140	136	3	1½
9	61	62	53	102½	102½	131	134	4½	4½
10	57	64	52	103	105	135	139	4½	3

* The heat of the water put in was, in all cases, 212 degs.

It will be seen from the above tables that the quantity of water varies very considerably, but it is only fair to state that in table A the machine had only fresh eggs in it, whilst in table B there were a few eggs with living chickens in them. It is surprising the difference the presence of a number of "full" eggs makes to the temperature, and consequently to the amount of water required. Each living chicken contributes to the heat of the drawer, and as a friend, who is working a Christy, told us the other day, "when the drawer is full of live eggs, the heat can scarcely be kept down."

This machine, as will have been apparent to our readers, can only be worked where a sufficient supply of hot water can be obtained. In summer, or if kept in a warm place, this can be done quite easily, but in the depth of winter—the time when Incubators are of the most use—the difficulty is not so easy to overcome. Of course, a large pan can be got to hold three or four gallons of water, but it is not every household that can allow the fire to be monopolised for an hour or two twice a day. In large establishments, where the kitchen boiler is always pretty near boiling point, the thing is easily managed, but the majority of those who have Incubators have not this convenience. Our own plan was as follows:—We placed the Incubator in a dressing-room adjoining the bath-room, and upon the top of the Incubator put a small gas-stove, upon which a large tin boiler, holding about seven gallons of water, was placed. As the heat of the water in the bath boiler was generally from 150° to 180°, it did not require a great deal of time to boil it; and, a tap being fixed in this tin boiler right above the inlet pipe, the water, *actually boiling*, was run into the machine. It is necessary, when this is done, to place a sheet of tin under the gas stove or the wood below will be charred by the heat, and, perhaps, set on fire. The only drawback to this plan is the expense, as a great deal of gas is

consumed in these stoves, and whilst we had ours at work it cost about 4d per day. It is only where gas can be obtained that this plan can be carried out, and in country places the machine must be worked by some other method. Where the machine is placed in charge of game-keepers or poultry-men who have plenty of time on their hands, the spending of an hour or two does not make any difference. We would recommend, whenever possible, that the machine be placed in charge of a woman—we use the word in its truest sense—for they have far more time and patience than we of the sterner sex. They appear to have an adeptness and art, which causes them to succeed where men fail; in fact, they, when they take a real interest in the matter, appear to have more of the “knack” we spoke of in our first chapter. Of course, there are ladies who do not possess this “knack,” and a machine is a useless thing with them. We would not, however, recommend a self-regulating machine being placed in the charge of a lady, as the delicate mechanism necessary for the regulation, is—with all due deference to the fair sex—a true *bête noir* in their hands, and, unless the worker has more mechanical knowledge than is generally possessed by ladies, will be too much for them.

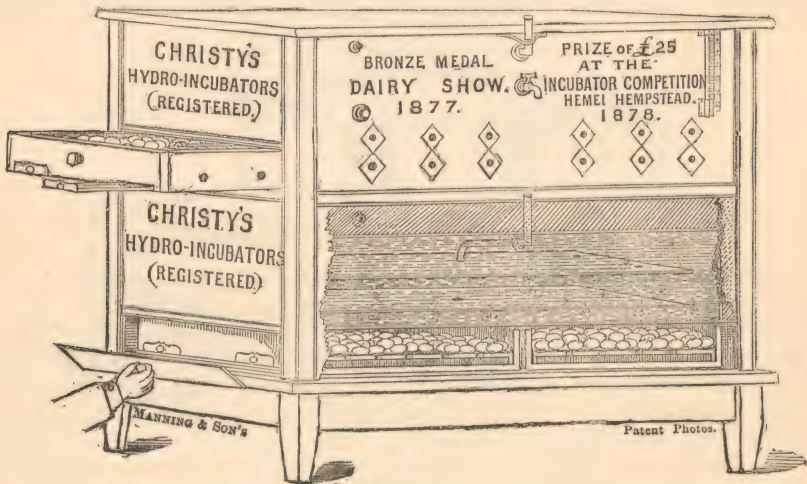


Fig. 5.

HYDRO-INCUBATOR FOR 500 EGGS : CONSTRUCTED WITH TWO CISTERNS AND FOUR DRAWERS, EACH CISTERN WORKING INDEPENDENTLY OF THE OTHER.

Many of our readers will wonder how it is that some persons succeed so well, whilst others utterly fail with the same machine, both working, apparently, under the same circumstances, and the wonder is a natural one; but we suppose it is just the same as in other matters, some have “a gift,” or a plodding patience, and succeed, whilst others, under the same, or even more favourable circumstances, have to give up in despair. This will, therefore, account for the different reports given by various persons. Of all that we have yet seen, that given by Mr Procter—(see appendix C)—is the most satisfactory, being a tournament between hens and incubators. In this case the eggs were from the same places, were not selected, and although the *per-centages* were not so high as others have obtained, yet it was a perfectly fair test on both sides, and the result is a “feather in the cap” for artificial incubation.

The merits of this machine are: its great simplicity in working; the regularity of temperature which it keeps, caused by the fact that the lower body of water is never disturbed, and that the hot water can only mix with the cooler water gradually; the freedom from objectionable smell which all gas and oil machines give off, and which may have some injurious effect upon the imprisoned chick; and last, but not least, its reasonable price. Its defects are: the large quantity of water required to work it in cold weather; the insufficient moisture given off by the earth trays (this could be remedied by making four small trays to fit each corner of the drawer); * and the position of the thermometer, which can only be seen by opening the egg drawer. But in spite of these, it is a very useful machine, and its introduction marks a new era in the history of artificial incubation, and we can thoroughly recommend it to anyone who has the time and means of working it.

The machine used in our experiments was a 100 egg machine, which is the smallest size made, it being found that a smaller one is more affected by the temperature of the atmosphere, there not being so large a body of water, and consequently the heat is more quickly lost. Messrs Christy make machines to hold 20, 80, and 500 eggs, and also one for ostrich eggs. Figs. 4, 5, 6, and 7 show these machines, and explain the various parts of each:—

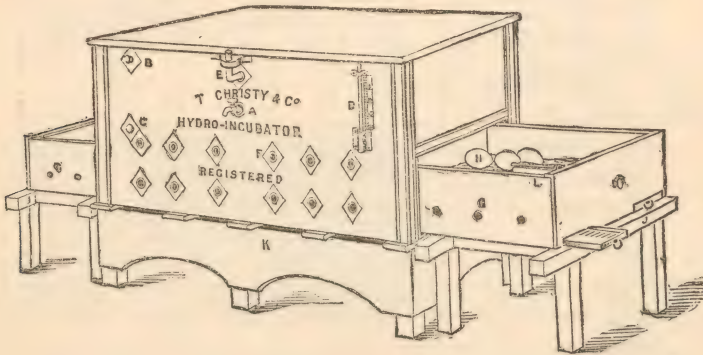


Fig. 6.

OSTRICH HYDRO-INCUBATOR ON STAND WITH DRAWER SUPPORTS.

A, tap for ordinary working; B, escape of air and steam; C, pipe to empty cistern completely; D, glass water gauge; E, pipe for filling cistern; F, air-holes; G, air-holes in side of egg drawers; H, eggs on flannel or felt; J, drawer supports; K, stand.

We append the following extract from Mr Christy's pamphlet on "Hydro-Incubation," explaining more fully Fig. 6:—"Great as was the want experienced in Europe for a means of supplementing Dame Nature's provision for hatching eggs of various kinds, nowhere was it more felt than in Algeria and Cape Colony, the Ostrich districts of the world. Very soon after the first introduction of hydro-incubators into England, a few machines of increased dimensions were sent out by me, and pronounced a complete success by the Ostrich farmers. A new trade was thus at once made, and an increased means of reproducing this giant bird opened up to the colonists engaged in the industry, and the hearty welcome accorded the hydro-incubators at the Cape is easy to be understood. Ostrich feathers,

* Since the above was written, a plan similiar to this has been adopted, and, therefore, this defect is now remedied.

commanding the price they now do on the market, and with young birds, two months old, selling for £10 a-piece, and a pair of laying birds occasionally realising as high as £400.

"The woodcut (Fig. 6) shows an Ostrich hydro-incubator on its stand, with a drawer support at each end and thermometer in the drawers. The size of ostrich eggs vary so much, the Algerians being much smaller than the Cape eggs; and, again, the eggs of wild birds being smaller than tame ones, that it will be safer to give the dimensions of an egg drawer (of which the measurements are 21 ins. $\times$ 21 ins. $\times$ 8 $\frac{1}{4}$ ins. each) instead of stating the number of eggs the machine will hold.

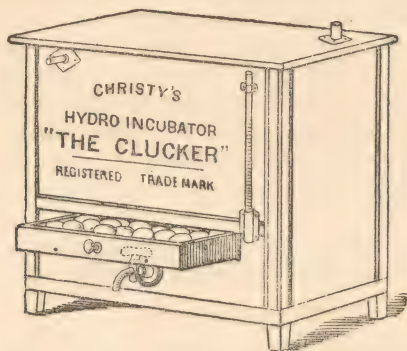


Fig. 7.

THE "CLUCKER." HYDRO-INCUBATOR FOR 20 EGGS.

"How the hydro-incubators have done their work at the Cape may be judged from the fact, that the representative of an eminent Bristol firm of merchants lately arrived home, and reported he had himself obtained 20 Ostrich chicks from 20 eggs entrusted to one of these machines. The Ostrich rearing-mothers described further on, were built to this gentleman's own design and at his request."

(See appendix C and D.)



CHAPTER VII.

THE VOITELLIER INCUBATOR.

This machine shares the unenviable notoriety of having completely failed at the Hemel Hempstead Tournament of Incubators in 1878, and, although previously well-known, its reputation received too severe a blow to very rapidly recover a place in public estimation. Its inventor claims its principle of being a "hot nest" alone, as entirely novel in artificial hatching. In a report to the French National Academy of Agriculture, M. Joubert says, that he looks upon the Voiteulier "as a true farm incubator, being as plain and durable as a plough or churn." This is true. He further says, that "the roughest-handed farm servant can take the management of it without fear of injury to its working." Be it now our duty to describe the machine and relate our experience with it, in order that our readers may, for themselves, determine how far we can endorse the latter statement.

A strong deal chest, 33 inches square and 21 inches deep, contains a cylindrical zinc cistern packed tightly round with sawdust; this hot-water tank is a foot in depth, and has 20 inches inside diameter. It exactly fits, and rests upon a circular wooden frame 4 inches in height, and this is the "hatching nest" (the English trademark), in which eggs are placed without any contact with the hot metal. It will hold 100 ordinary fowl eggs, or between 70 and 80 duck eggs. Two moveable glazed frames, fitting the one over the other, are provided at the top of the machine, allowing either of access to the eggs when lifted off, or of a glance at the thermometer, leaning upright inside, at any time without opening. The inlet pipe is at the right hand top corner, and the only outlet tap is at the bottom. In the centre of the front is a pipe to supply air, but the latter is always warmed before being admitted to the incubator, by reason of a considerable length of the pipe running alongside of the cistern. The air has no direct contact either with the eggs, inasmuch as the pipe rises 9 inches inside, and a current is secured at the top by the aid of a very small piece of piping, through which (in the published theory) it is supposed that the steam from the hot water escapes, and so damps the eggs sufficiently. Suffice it here to remark, that were this the only moisture supplied, the per-centage of hatchings would be small indeed. The cistern holds 20 gallons of water. The nest is prepared by placing fodder, or bracken, on a layer of sand, or gravel, an inch in thickness. The latter is kept damp, and thus the atmosphere in the machine should not only be always of a proper temperature, but moist as well.

Being a hydro-incubator, the remarks upon the supply of hot water made upon the Christy machine are equally applicable to the Voiteulier. Many ordinary households would be far too much interfered with in the domestic arrangements to be enabled to supply the requisite quantity of boiling water twice a day to replenish the incubator. Our own stands in a large kitchen, and we have but little difficulty in this respect; we, therefore,

speak of ours under favourable conditions. We found it necessary to change 3 gallons of water at least twice per diem. We have a can and kettle, both holding half that quantity. We reboil the water we draw out, generally. In very severe weather we have changed between 4 and 5 gallons at night, for the fact of the fire going out before morning has to be taken into consideration. In the day time the temperature of the kitchen does away with the necessity of boiling up more than 3 or $3\frac{1}{2}$ gallons of water. No rule can be laid down to guide an unskilled operator in water changing, but practice soon gives him the requisite "knack" of telling from a glance at the thermometer how much he will require to carry him on, either through the day time, or night, as the case may be. In any regular establishment for artificial incubation, where a quantity of machines are working, and every requisite is to hand, with constant attention and careful supervision, of course this difficulty must be overcome entirely, and all irregularities of temperature would disappear. We are supposing that an amateur has a single machine. During the sharpest days of the past winter, we made a practice of getting the change of water made as late as possible, viz., at 11 a.m. and 11 p.m., so that in the early morning the servant could, if necessary, soon add a little boiling water, if the heat registered too low for safety, and we hatched very successfully throughout February, March, and April.

Care has to be taken when the top lids are off for the purpose of attending to the eggs, that the latter are not exposed for too long a time. The inside cistern-surface is so large to come in contact with the outer air of a lower temperature, that it loses a large proportion of its heat rapidly, and when the covers are replaced, and boiling water run in, a considerable time seems to elapse before the effect on the inner air is appreciable. This danger points the reader, however, to the ease with which too high a temperature is remedied. "No top contact" is M. Voitellier's principle, so that no alteration can well be made in his machine in this respect, but, in our opinion, it constitutes a danger requiring more delicate care and judgment than "the roughest-handed farm labourer" (as a rule) is possessed of. Nature is not imitated without top-contact. Here the eggs are subjected to a moist heat of 104 degs., and according as they contain germs of strong or weak constitutions, hatchings take place more or less freely.

That the Voitellier deserves a measure of success, is testified to by the important results experts are claimed to have obtained with it, and we may reasonably hope that its inventor may yet prove, in an open competition, that in his hands it will perform its work as creditably as it has hitherto done in his own country. It is, in many respects, a convenient incubator; its air supply requires no regulation; its arrangements for moisture are simple and effective, apparently; its price is tolerably moderate; the thermometer can be consulted with ease and without exposing eggs; and the young chicks are provided with a nest, which seems in every way suitable to them from the moment of chipping to that of hatching out. Against these merits must be weighed the close attention it requires, as well as the large quantity of boiling water. Still if hydro-incubators are not toys, but elements of commercial enterprise, the last consideration would not be worth a thought, as proper appliances would be absolutely requisite.

CHAPTER VIII.

HOWELL'S GEM HATCHER.

The "Gem" Hatcher is made by Mr. F. Howell of Dunstable, Beds, a gentleman who has taken very great interest in the question of Artificial Incubation, and who has worked this machine very successfully. It is upon the same principle as Christy's Hydro-incubator, and held third position in the last trial of machines at Hemel Hempstead, being scarcely 1 per cent. below that of Mr. Cashmore. It is made in two sizes, namely, 60 and 100 egg respectively, and the larger machine did the best work, the smaller machine being nearly 20 per cent. below the larger one in results.

The difference between this machine and that of Messrs Christy & Co., is the egg drawer, which is a tin tray, has very good arrangements for moisture, and the eggs are laid upon straw as in the Voitellier machine. The glass gauge which registers the height of the water is abolished, but this is a very questionable improvement, and one which might be called an improvement backward.

Mr. Howell claims that in his machines, much less water is required to work than in the Christy, and, of course, this is a great advantage. It is doubtless through having a larger body of water, the larger machine holding about 25 gallons. Other than this, it is very similar to that machine, and the remarks made upon it in chapter VI. will equally apply to the one made by Mr. Howell.



CHAPTER IX.

HOW TO MAKE AN INCUBATOR.

We have received a number of letters asking how to make an incubator, and for the benefit of these correspondents, and the many others who may be wishful to have this information, we give the present article, not for a moment wishing to recommend the plan to anyone, but simply because there are so many persons who will make a machine if they know how, but who would never think of buying one. The plan of making an incubator of one's own will probably be the dearest in the long run, as one article made to a certain pattern must cost a great deal more than when a dozen or two can be made. Besides, home-made things are often badly made, and experimentalists in this line can bear testimony to the disappointments and vexations which have to be endured. The great drawback to such attempts has been that every one has begun *de novo*, and if they have at last succeeded, they have only done so by great study and perseverance, and after a long and expensive time has elapsed. We now hope to remedy this by showing how good machines can be made, and in doing so, will build our structure upon the knowledge gained by long and patient study.

HYDRO-INCUBATORS.

A hydro-incubator is comparatively of easy construction, but the price at which they are being sold now-a-days, makes it doubly questionable whether any one desiring to have one, had not better at once buy one ready-made. If not, a square tank must be made of sheet iron, say about 2 ft. square, with three 1 in. holes, and a $\frac{1}{4}$ in. hole in it as in Fig. 8.

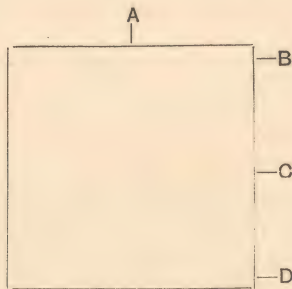


Fig. 8.

A is inlet ; B air hole ($\frac{1}{4}$ in.) ; C tap for drawing off water ; D for emptying tank.

In A and D a short piece of piping with screw caps must be soldered, and in C, the same with a screw tap. But, before the tank is put together, the inside must be so arranged that the hot water shall not run to the bottom

as it is put in at A. This can be done by inserting a tube at A, half-way down the tank, at the end of which four arms are fixed with holes perforated in them on the upper side only, and the water will thus be turned upwards. This tank must be placed in a wooden case with about $1\frac{1}{2}$ inches of space all round the sides and top, 9 inches between the bottom and the floor of the case, and with holes to allow the tubes mentioned to come through. When the sides and top are well packed with felting, sawdust, or any good non-conductor, in order to keep in the heat, the top securely fastened down, a drawer to hold the eggs to fit the place made for it, two rows of holes bored through the sides of the machine and drawer for the circulation of the air, and trays made to provide the moisture, the thing is about complete and ready for work. These trays had better be made of tin, and narrow, but to fit the drawer, the full length of it. The bottom of the drawer had better be made of perforated zinc, below which shallow tins can be placed, and filled with earth (as those in the drawer should be) and kept damp to provide under moisture.

SELF-REGULATING INCUBATORS.

We have received one letter, asking for instructions how to make a regulating lamp for an incubator, but we regret we cannot satisfy our correspondent; there are so many difficulties in the way that we do not feel we could give instructions really useful, without actually describing some now in use, and we do not think it fair to the inventors of those machines to do so. In fact, in making a lamp machine, the incubator must be built to the lamp, and to meet the requirements of the latter.

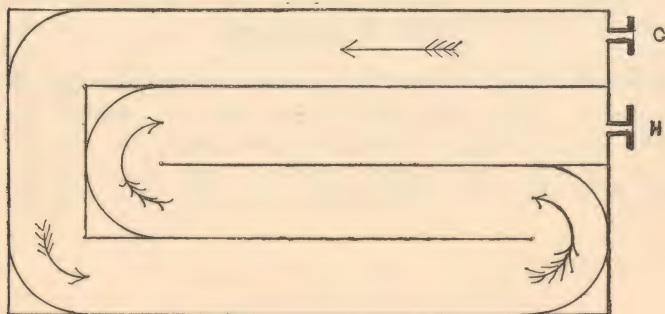


Fig. 9.

In the machine we are about to describe, we will not give dimensions as to the actual size, that may be left to the maker, according to his own pleasure and requirements, but a machine with the tank 3 feet by 2 feet will hold over a hundred eggs, and that will be a very good guide to him.

Fig. 9 is the tank, which must be made of strong tin, about 9 inches deep with partitions to guide the circulation of the water as shown on the plan. Inlet and outlet pipes must be inserted at the places shown, the former about 2 inches and the latter about 5 inches from the top of this tank. These pipes had better have screw joints which must be made to fit the corresponding joints on the boiler (Fig. 10). Care must, of course, be taken that this is made perfectly strong and water-tight.

Fig. 10 is the boiler, which should be made of the same material as the tank. This is round, about 4 inches wide and 6 inches deep; inside is fixed a sort of inverted funnel forming the compartment for the gas burner and the chimney, the latter being about an inch in diameter, on to the top of which (outside) an additional pipe must be fixed to carry the smoke clear above the machine. In the inside of the boiler, midway between the outlet and inlet pipes a partition must be made, so as to compel the water to circulate round the boiler whilst being re-heated. When this is done, and the connections with the tank made perfect, the boiler is complete.

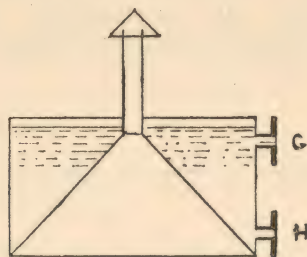


Fig. 10.

The next thing to be done after making the tank and the boiler is to prepare the case, which needs little description, as anyone with mechanical ideas can at once see what is required from Fig. 11, which is the machine complete. A close fitting lid, lined with tin, must cover the tank, and being made to open, is useful for filling the machine. To facilitate the emptying, a tap (not shown on plan) must be fixed in the bottom of the tank at the back. The egg drawers must be made same as described for Hydro-incubators, with ventilating holes in the sides also.

The most important point to be decided is that of the regulator, and we would recommend all who are making a gas machine to obtain an electric regulator, which can be procured through any electrician or optician. We do not know the name of the maker, but procured ours through Messrs Mawson & Swan, of Newcastle-on-Tyne. This regulator appears rather complex at first sight, but is very simple indeed, and needs scarcely any attention. It consists of (1st) the battery, (2nd) the regulator, (3rd) the thermometer, and (4th) the platinum connecting wires.

The *modus operandi* is as follows:—The battery, M, is charged with Sulphate of Salimonica, and this is connected with the regulator by a piece of the platinum wire. Another piece of this wire is then carried through a small hole in the side of the case to the thermometer, N, and affixed to a small piece of wire passed through the glass bulb, so as to come in contact with the mercury; the thermometer being heated to, say 105 degs., another piece of the wire is inserted into the fine pin-hole at the unsealed end, so as to touch the mercury there, and carried from thence to the battery again, thus making the circle complete. When it is in operation, and the mercury rises sufficiently to touch this wire, a piece of soft metal in the regulator is so acted upon by a magnet, as to almost entirely plug the gas passage up, and thus reduce the flame to a very small one, remaining so until the heat falls again, when, the mercury by falling breaks the circle, and the plug returning to its place, the flame springs up at once to its original size. A screw is attached to the regulator, which can be so used as to make the gas flame just about the size required, and to prevent unnecessary use of the battery.

This regulator is undoubtedly the most perfect one out, working by the actual heat in the egg drawer itself, and is so fine in its operation that the temperature of a machine can be kept to a quarter of a degree. The cost is, we believe, about 30s, and that is its greatest drawback. Shelves should be made at the end of the machine as shown in Fig. 4, upon the lower of which the battery and regulator will rest, and upon the upper the gas burner. The pipe from the main must be connected with the regulator by a piece of India-rubber tubing, and another piece carried from this to the burner, which anyone can fix. When the tank is filled, let the water be about 120 degs., and when it has fallen to 104 degs., the gas may be lit and the apparatus set in motion. All the attention it will then need will be to occasionally see that the battery is properly charged with the sulphate.

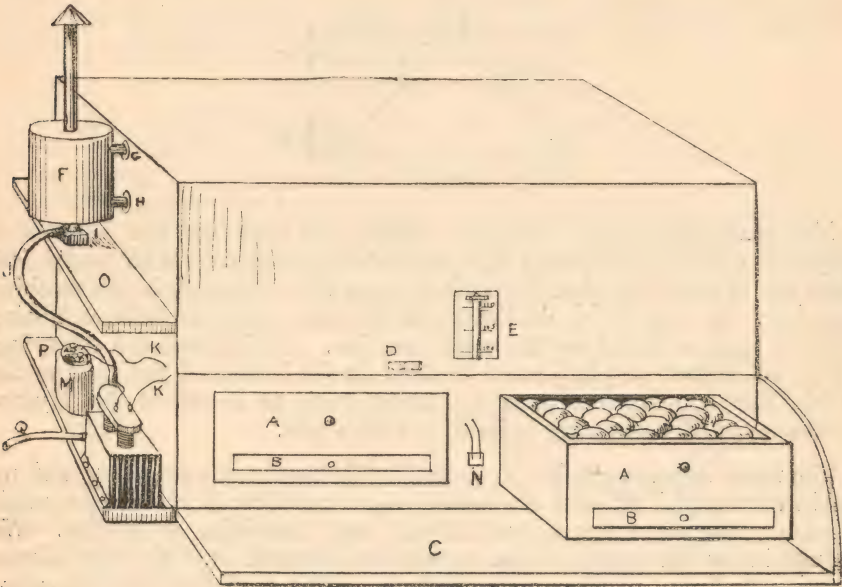


Fig. 11.

- | | |
|---|---|
| A A. Egg Drawers | I. Gas Burner. |
| B B. Earth Trays below Egg Drawers. | J. Gas Tubing from Regulator to Burner. |
| C. Door for front; used as rest for drawers when drawn out. | K. Platinum Wires for Regulator. |
| D. Button for fastening door. | L. Regulator. |
| E. Thermometer. | M. Battery. |
| F. Boiler. | N. Thermometer for Regulator. |
| G. Inlet for hot water to Tank. | O. Shelf for Gas Burner. |
| H. Outlet for cooler water. | P. Shelf for Regulator. |
| | Q. Tubing from Regulator to Main |

CHAPTER X.

HINTS ON THE WORKING OF AN INCUBATOR.

A few words will sum up our remarks upon artificial incubation, which will enable the readers to understand the principles and mode of working each machine on the market, and decide which is most suited to their own requirements and advantages.

The three great things necessary to success in incubators are—first, regularity in the heat; second, attention to the details; and third, the condition and freshness of the eggs.

So far as the first is concerned—the regulation of the heat, this needs to be attended to at the first, as, no matter what make of machine you may be working, it is of no use unless the heat is regular—*i.e.*, does not vary more than 3° or 4°, say between 101° and 105°, but, of course, if you can keep it without variation so much the better. The way to best secure this regularity is to get to understand its working before you attempt to put any eggs in. If needed, spend a few days in getting to thoroughly know your machine, as it will not be time lost, but may be money gained, by saving many eggs that would otherwise be spoiled through your inexperience. Above all, if a purchased machine, study the directions well, do not jump at conclusions as to what certain things mean, and do not be impatient.

The second point, attention to the details, is almost more important, if that be possible, than the first one, but is certainly of equal importance. We can quite conceive, nay, we know it, that a machine may be regulating perfectly, and yet, simply because some one of the details has not been attended to, not a chick is hatched, although every one is fertile. The most important of these details are, moisture, air, proper turning and handling. So far as the first is concerned, we hardly think too much moisture can be given, we mean by evaporation, as we do not believe in sprinkling or damping eggs, and this should be provided for both above and below the eggs by means of earth trays kept damp. Air is necessary, but in cold weather, if the air holes are not filled with cotton wool, the eggs will be chilled, and great attention and careful thought must be given to this. A good plan in cold weather, is to nail a piece of coarse sacking just above the air holes, allowing it to hang over them, and whilst this will not take the place of the wool, it will act as a protection in sudden changes of temperature, but in warm weather be sure and take it away, giving the eggs all the air you can. There is another point which should be mentioned, and that is the airing of the eggs in cold weather. We lately adopted the plan of having a piece of flannel warmed ready, and covering the eggs with it as soon as the drawer was opened. This preserves them from the sudden chill which is so destructive to the chick. The proper turning can be done by placing the eggs in rows, and slightly canting the drawer, then, if the bottom egg is removed, the others roll gently down without any jarring or undue handling. As each lot of fresh eggs are put in they must be placed at the side and the others moved towards the centre. By this means the eggs are properly turned, and the handling of them reduced to a minimum.

The third and last point we need touch upon is the condition and freshness of the eggs. By condition, we mean shape and cleanliness, for no eggs ought to be put in that are out of the ordinary, and all eggs ought to be clean on the shell. If necessary, wash them in water about 65° or 70° before putting in, but if by any means they get dirty in the machine, let the water then be 103° to 105°. Eggs ought always to be fresh when put into an incubator, we should say never more than a week old, if possible, but there is a point which we feel has even more to do with successful hatching than even the freshness of the eggs, and that is the kind of fowl from which they are procured. The fact is, we have, after repeated trials, come to the conclusion that whilst eggs from common or cross-bred fowls will hatch splendidly, better than they will under hens, eggs from fine, or in-bred stock, will hatch very badly, worse, in fact, than they will under hens. Why this is so may not be far to seek, as all know that even under hens high-class eggs hatch badly compared with common ones, and in an incubator the eggs, not having the careful attention of the hen, either die in the shell whilst hatching, or soon afterwards. And we think this rule will be found to vary accordingly as the breed is hardy or delicate, coarse or fine bred, and it will be found that in the newer varieties of poultry, those that have not had time to deteriorate by long breeding for purely fancy points, the eggs will hatch fairly well, whilst in the older ones thus deteriorated, they will hardly hatch at all. This theory accounts for the varied success which many fanciers have experienced, for when they first began to use a machine they put only common eggs into it, which hatched well, and by-and-bye, when they put in their best ones, failure was the result; or, take another view, if we examine the published testimonials of the various makers, we find those who succeeded best are not the fanciers whose birds figure as prize winners at our principal shows, but evidently persons who do not weaken their stock by exhibiting and fine breeding. Of course, those exhibitors who have really unlimited runs for their birds, are not likely to suffer so much as those whose birds are penned up, for the former gain stamina and strength to counteract the fine breeding or exhibiting.

It will be seen, therefore, we have come to the conclusion, that incubators are only suitable for the incubation of eggs from birds whose constitutions have not been weakened by the causes named, and we must confess that we have reluctantly done so, but we give our own experience, and what we have been able to learn of the success of other experimentors. That incubators will come into more general use, we do not doubt, and we hope to soon see the time when many farmers will possess one or more, and devote some small portion of the attention now given to unprofitable produce to poultry. In their hands, and with somewhat improved breeds of birds, incubators would be a success, and would hatch ducklings and chickens for them, so that they might sell them when they are scarce and dear. Ducks eggs can be hatched at almost any time of the year, and the ducklings are so easily reared, that we can recommend all who have any convenience to go in for this branch of poultry farming. We hope some day to resume the subject, but upon a different phase of it, namely, hatching houses, in which we have great faith, and upon which we intend to experiment, unless some one forestalls us, as soon as we can spare the necessary time.

CHAPTER XI.

HINTS ON THE ARTIFICIAL REARING OF POULTRY.

It is often asked by persons to whom the principles of Artificial Incubation are being explained, how the chicks are to be reared after they are hatched, it being supposed that they will miss the constant care and watchfulness of the mother hen during the period of chickenhood. This, however, is a comparatively easy matter, and we will now briefly give a few hints on this important subject, for important it certainly is, as when the chicks are hatched only half the work is done, it being as necessary to success for the chicks to be safely reared as to be hatched, and without one the other is of no use whatever.

The artificial rearing of fowls has been a pet subject with the writer for some years, and for four seasons before he hatched a bird artificially, every bird hatched under hens in his yard was transferred to an artificial mother, and there reared, in most cases the hen being made to do duty a second time in hatching out another lot of eggs. The machine used for the purpose was one of Mrs. Frank Cheshire's artificial mothers, of which we shall shortly speak, and some hundreds of birds were reared successfully by means of this mother, many of which were prize takers at the chief exhibitions in England.

The success attained the first year was marvellous, only two chicks dying out of some sixty put into it. But the next year the per-centage of loss was much higher, being about twelve per cent., the cause being one that was not discovered for some time, and was little suspected. The first year the mother was placed under a rough shed, being simply some deals nailed together to form a roof, the sides being opened to the four winds of heaven. The result of this arrangement was, there was no coddling whatever, and the birds were obliged to come out into the open air, wet or dry, to get their food. In spite of this drawback they thrived again, and some birds that were hatched out of eggs from the same fowls the same day, but reared under hens, were compared with them at five weeks old, the result being that the former were nearly twice as large as those reared in the natural way. The drawbacks to the mother being thus exposed were: there was some trouble with the lamp in windy weather, but by the use of old sacking this was partially avoided after a time; and, also, the exposure to the attendant whilst cleaning the mother out. It being thought that the chickens would thrive all the better if more protected, the following season a large shed was built, in which to place the mother, and to avoid the trouble with the lamp, gas was used in its place, but the result was by no means satisfactory. In after years the same was experienced, and whenever the mothers were placed in an open place with plenty of ventilation, the mortality was very small indeed.

All the makers of Incubators have mothers to accompany their machines in one form or another, some connected with the Incubator, and others entirely separate. The Boyle and Penman machines have the mothers connected, but all the others we have referred to have them separate, and we

think this latter the better plan, as the chicks can only be kept in the former for a short time, and must be then transferred to an outside mother. The mothers sold separate are all worked on the same principles as the machines they accompany, and it is therefore unnecessary for us to describe them.

It may be as well to describe Mrs. Cheshire's artificial mother at some length, as at one time it was used by many breeders, and, until the introduction of the hydro-rearers, was the only machine prominently on the market. It has, however, since that time declined in public favour, the cause being that these hydro-rearers are much cheaper, and have no lamps to get out of order.

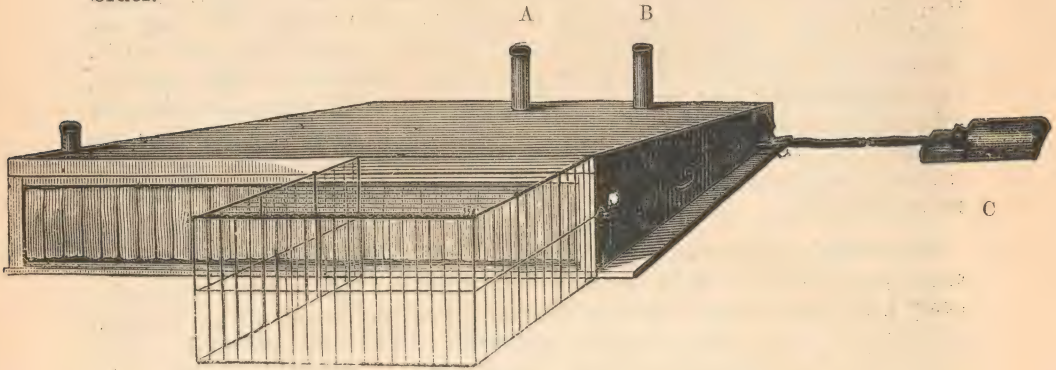


Fig. 12.

This machine is the invention of Mrs. Frank Cheshire of Acton, Middlesex, who, at one time, was well-known as a breeder and exhibitor of light Brahmas. Fig. 12 shows the appearance of it, and it may be briefly described as a box 3 ft. long $\times$ 21 inches wide. In this is inserted a tank 1 in. thick, in which is placed 9 inches from each side (the tank being only 18 inches wide), a strip of tin the full length of the tank, with perforated holes at each end to allow the proper circulation of the water. This tank becomes 3 inches thick for 3 inches at the back, and in this a tunnel is placed, with two chimneys 12 and 24 inches from the end (A & B). On the under side of this tank is the compartment for the chicks, being 6 inches high at the front and 3 inches at the back. To prevent the backs of the chicks coming against the hot metal, a wooden frame is made to slide under, on which is tacked strong canvas, and to this are stitched pieces of flannel cut to represent the feathers of the hen. The heat is obtained from a benzoline lamp (C), which has a tube about 20 inches long, preventing any danger from the inflammable nature of the oil, and smoking is prevented by a small piece of shaped tin. This machine is a most useful one, and we can thoroughly recommend it, but we think the strips of flannel would be better done away with as they tend to make the inside too close and confined. Holes, also, might be drilled through each end of the frame to provide for ventilation.

Christy's hydro-rearer is, as we said before, worked on the same principle as his Incubator, Fig 13 being an illustration of it. In it good provision is made for ventilation, and chicks can be reared easily by means of it. For the open, what is called the "open air rearer," can be used, which provides for the protection of the mother and inmates against the weather, and also for the latter against cats or vermin.

In the management of rearers the first great thing to remember is not to get the mother too hot. This is undoubtedly the cause of death in many cases, and, we think, the heat in a mother should seldom be over eighty degrees, in fact ten degrees below that will be all the better, except for the first few days. When the chicks get to five or six weeks, or sooner than that if the weather be at all mild, they thrive better without any artificial heat at all. Where a large number of birds are being reared, it is necessary to have several mothers so that they can be separated according to their ages, or, if crowded, the older ones will themselves take the warmest places, and compel the little chicks, who require the most protection, to go to the outside.

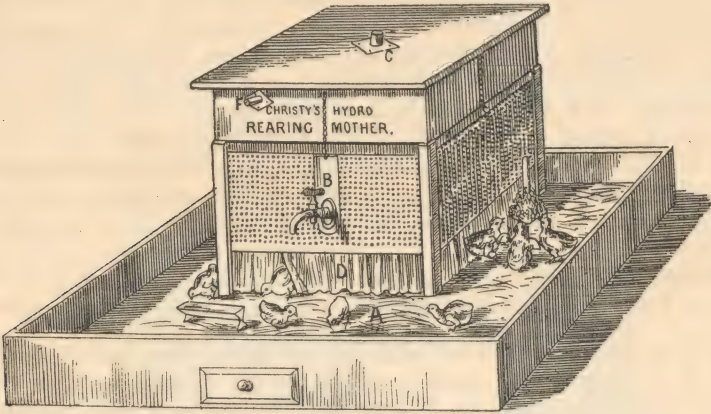


Fig. 13.

A—Park for chickens ; B—Tap for emptying cistern ; C—Tap for supplying water ; D—Curtain to mother ; F—Air hole.

The next great point in the using of rearers, is the proper attention to cleanliness. Without this all efforts will fail, and great mortality will be the result. This is best attained by the plentiful use of dry soil, in which has been mixed a little carbohc powder, and this used, fresh being put into the mother every morning, it will be perfectly clean and sweet. But in addition to this we would suggest that the mother be exposed to the air every day for a short time, to clear away the foul air, which would otherwise remain in it. At the same time, it is needful that proper ventilation be provided for, but this can easily be done without causing any draught.

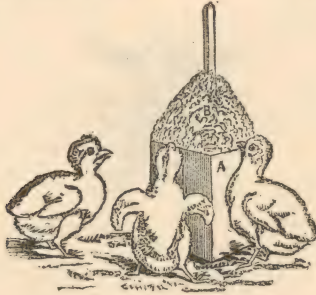


Fig. 14.

Chickens reared by a hen obtain through her exertions a large amount of exercise, and some provision for giving this must be adopted, when they are reared artificially. One of the best things we know is a lettuce, or, when older, a cabbage suspended by a string, and just above their reach. This will give them an abundance of employment, doing them an incalculable amount

of good. The pedestals sent with Christy's mother (see fig. 14) are capital things for the same purpose, the food being piled on these, and the chicks have to stretch up in order to get it. Another advantage is; the chicks cannot trample it under their feet as they do when placed in dishes, and the food is really eaten, not wasted. Many ways may be devised of giving the birds exercise, such as scattering the food, &c., but what has been mentioned will be suggestive enough to the reader.

Many of those who have had no experience in artificial rearing, wonder how the chicks are taught to feed, as it is the hen that has this office to perform. The matter, however, is a very simple one. Generally, after having been hatched some 24 hours, the desire for food is quite enough, and they eat up the food without any trouble. Sometimes they appear not to know the way, and in this case an older chick can be put with them, or if one is not available, let the food be placed on a board, and a pencil or penholder tapped a few times upon it, to imitate the peck of a hen, and this is sufficient. The first food for chicks should be hard-boiled eggs and bread crumbs, to be continued for three or four days; after that, oatmeal, boiled rice, Chamberlin's Canadian meal, Spratt's poultry food, or crushed sea biscuits can be given, and if the weather is at all cold or wet a little aromatic compound should be mixed with these. When they reach three or four weeks old, hempseed or buckwheat can be given, and a little further on, wheat. Milk for a few days should be the only drink, and then milk or water.

Some who use incubators for hatching, rear under hens, and if this plan is adopted it is necessary to have hens sitting on dummy eggs, so that the chicks as they are hatched can be transferred to the hens. This is best done at night, when the eggs under her can be removed, and the birds put in their place. The drawback to rearing birds under hens is the risk of having them trampled to death, but, of course, the trouble to the attendant is much less.



CHAPTER XII.

RECENT INTRODUCTIONS.

MESSRS. BLAIR AND BIRKS' "RELIANCE" INCUBATOR.

This machine (Fig. 15) is also upon the hydro or hot-water principle. It has an admirable plan for the regulation of the ventilation—namely, each hole is supplied with a pair of covers, one being perforated zinc and

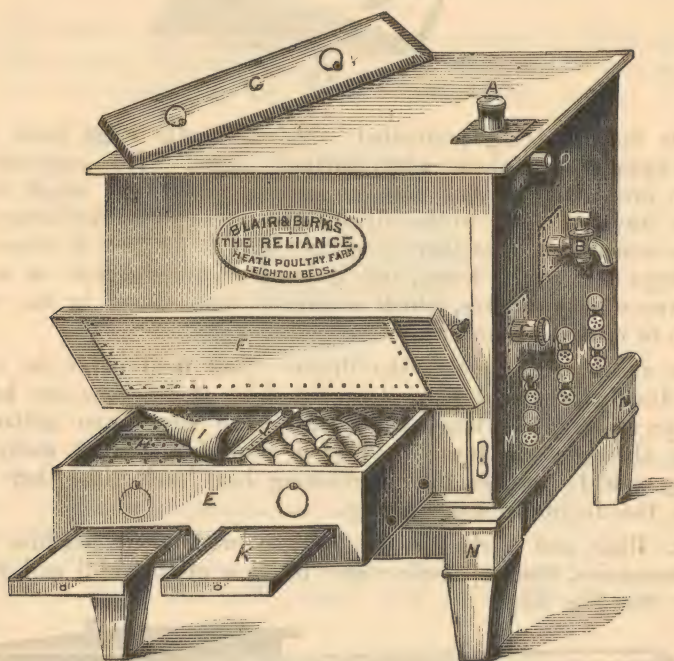


Fig. 15.

the other unperforated. By means of these the supply of air can be regulated to a nicety, and the holes can be entirely or partially closed, or left open at the will of the operator.

The "Reliance" machine, of which we have heard very favourable accounts, is made by Messrs. Blair and Birks, of Leighton Buzzard, but has never yet been submitted to a public trial; those gentlemen declining to enter it at the Hemel Hempstead trial of 1879, on the ground that one test was not sufficient to decide upon the merits of any machine, as an unexpected and unavoidable accident or mistake might spoil the chance of even the best Incubator. The "Reliance," therefore, has stood aloof, and whilst it has not received the attention it would have obtained had it won any of the public trials, it has not been injured in the eyes of purchasers as it would have been had it failed at such trials.

There are one or two important features in connection with the drawer of this machine which are worthy of special mention, Fig. 16 being an illustration thereof. This drawer has a hinged front, A, so as to let down, thereby allowing free access to either egg-tray or earth-tray without removing the drawer from its place. The egg-tray, B, is entirely of

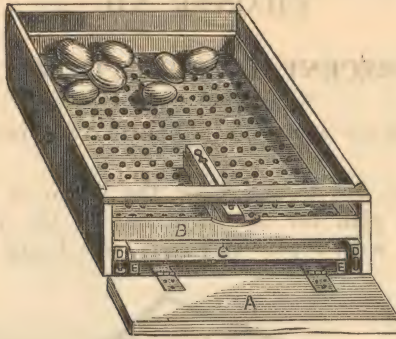


Fig. 16.

metal, the bottom being perforated with sufficiently large holes to prevent the eggs rolling about when partially filled. This egg-tray slides upon two brackets, D, fitted with adjustable screw feet, which raise or lower the tray according to the size of the eggs. The earth-tray, C, is also quite detached, so that there is no necessity to displace it when taking out the eggs each twelve hours, and it is of such dimensions as to afford a large vapourising surface, which is always kept warm by the tray not having to be removed from drawer.

By the above arrangements the drawer itself need never be removed from the Incubator, except when large numbers of chickens are hatching, thereby preventing the wood surrounding the eggs from getting cold each time the eggs are turned. This is a most important gain, as the eggs very quickly recover their incubating heat each time they are replaced in the Incubator after airing.

Messrs. Blair and Birks have introduced with their machine several capital accessories, their open-air rearer being a most useful and complete mother. (See Fig. 17.)

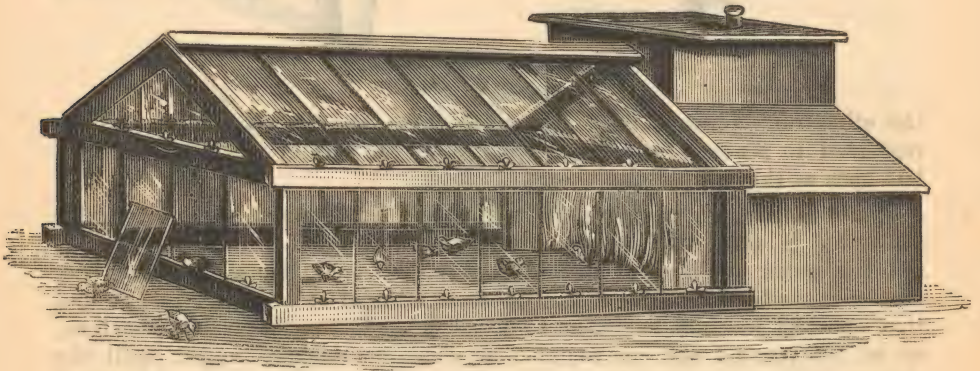


Fig. 17.

THE "RELIANCE" OPEN-AIR REARER,

Consisting of "Reliance" Mother, with Adjustable Legs, Glass Run, and Sunshades.

These rearers are much more satisfactory than the ordinary in-door mothers, and the success in them is also much greater. Another accessory is a small mother called a "Coup de Grâce," which can be used as a preparatory Incubator, for the purpose of warming the fresh eggs which are to be placed in the Incubator, (it is expected this will obviate many of the evils of constantly adding eggs to the drawer) as a drying box for the young chicks, and also as an initiatory mother. An ornamental run is provided when used for the last-named purpose, in which the birds can be kept for the first few days.

The "Reliance" cold rearer will be found useful, especially when the weather gets warm, the older chicks thriving much better without any artificial heat.

Later on I shall have something to say about other introductions made by this firm.

THE PATENT "EGG-OVEN."

Miss May Arnold has just introduced and patented a Hydro-Incubator, which she names "Egg-Oven" (Fig. 18). This machine is said to require only six quarts of hot water every twelve hours. A hinged

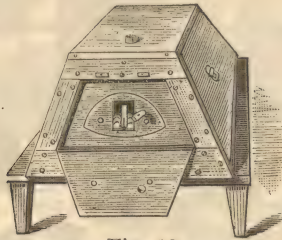


Fig. 18.

door, with a sheet of glass in it, admits to the egg compartment, the bottom of which is slightly concave, and the eggs are laid upon a bed of straw. Moisture is provided by means of a small pan in the centre, and the necessary air can be given by plugs in the front and back; these being hollow the supply can be easily regulated. I have never tested this machine, but have heard very favourable reports as to its working.

MESSRS. T. CHRISTY AND CO'S. IMPROVEMENTS.

Messrs. T. Christy and Co. have lately introduced several very important improvements, one of which, the new heater, is noticed under the head of "Heating Apparatus." In the illustration there given (Fig. 26) it will be noticed that the thermometer can be seen without removing the drawer, a much-needed arrangement. They have brought out a drying box in which the chicks are placed as soon as hatched, instead of being left in the drawer or put in a basket by the fire, and also a cold mother for older chicks, to which birds three or four weeks old can be transferred, thus relieving the ordinary rearers, and allowing the younger birds a better opportunity than if young and old are kept together. One of the most useful of their introductions is a small mother and run, (Fig. 19), suitable for a breeder who only wishes to raise a few chicks, and for whom, therefore, the other mothers are much too large. This apparatus is most complete, and can either be placed in the open, in a shed, or the house.

It is, of course, on the Hydro principle, and as will be seen, has a glass covered run, and sloping roof for the mother.

A new machine is now being made by Messrs. Christy from the suggestions of Mr. A. Comyns. As will be seen from a letter written by that gentleman to the Editor of the *Live Stock Journal* in June last,* he worked with two machines, in one of which—"The Clucker"—the eggs were kept for the first nine days, when they were transferred to the other. This gave much better results than he had obtained with only one machine, in which the eggs were perforce to be kept all the period of incubation. The machine now introduced, called "The Fancier" is designed to obtain all the advantages of the two Incubators in one machine.

The working portion of the machine differs in no way from the Hydro, the difference being entirely in the egg drawers, two of which are provided, being separated by a wooden partition which prevents one drawer being at all affected by the other. The object sought is to keep

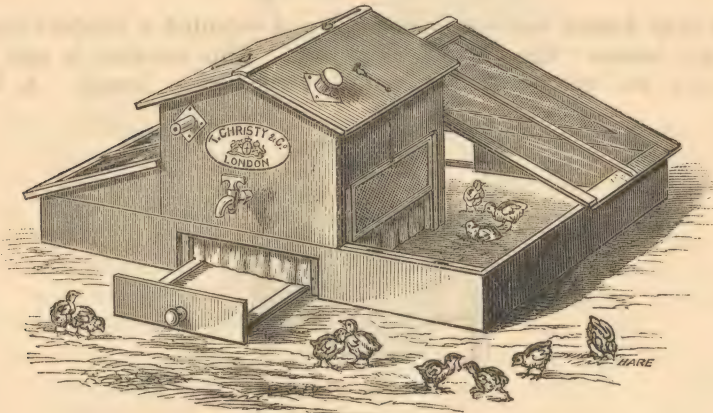


Fig. 19.

the eggs during the first nine days in a warm, moist, and unventilated atmosphere, and the remaining time of incubation in a well-ventilated one. One drawer, therefore, has no ventilating holes, and the other has them all round. The difficulties in the way of attaining both these objects in one machine are, (1) that the heat in an unventilated must be greater than in a ventilated drawer; and (2) that when eggs containing live birds are in the latter drawer, their own heat will considerably affect the temperature of the machine. It will thus be seen that when the Incubator is at work, both drawers being filled, the want of ventilation in the one and the natural heat of the eggs in the other will counterbalance each other to a certain extent. In order, however, to avoid any risk the egg-trays are provided with screws, so that they can be raised or lowered at will, and with a little practice the temperature can be kept at a proper height in both drawers. I was shown the record of his first trial by Mr. Comyns, and it was very even indeed. The result of the first twenty-four eggs put in was as follows:—four unfertile, one added, sixteen hatched, and three chipped. These latter (I saw them the day before they were due) gave every promise of being hatched out in a short time. So far, then, as the first trial is concerned it must be pronounced a splendid success, and I think that "The Fancier" will be found a most useful machine for those who have no need for a large one.

* See Appendix D.

MESSRS. DUNN AND CARTWRIGHT'S "TUBULAR" INCUBATOR.

This machine is made much on the lines of the Hydro-Incubator, but provides for ventilation in a different manner. A sliding shutter is fitted in the door of the egg compartment and one at the back of the machine. These are made similar to railway carriage ventilators, and as they will regulate the current of air, or shut it off entirely, I think this an improvement on the old system. The thermometer, also, is made easy of access, and by means of a small slide can be drawn out at any time, without opening the drawer.

The Incubator is filled with water in the same way as a Hydro, but in this body of water there is iron tubing put, which communicates with a boiler placed at the side of the machine. This boiler is heated by a lamp or gas, and the water circulating through these tubes keeps up the heat in the tank. No regulator is required, as the water in the tank is not brought into the boiler, and the makers claim that no difficulty is experienced in keeping an even temperature.

A capital double rearer on the same principle is supplied, and Messrs. Dunn and Cartwright also make machines without the heating apparatus.

THE MONTAUBAN PATENT CABINET INCUBATOR.

This machine is of recent introduction, and is the invention of Mr. Marco Wilhelm Montauban-van-Swyndregt, of Coleman Street, London, E.C., who has patented the same. It is made in four sizes, to contain 12, 25, 50 or 100 eggs. The machine is very simple in appearance, and I have been struck with its practical appearance. The 25 (Fig. 20) egg machine is

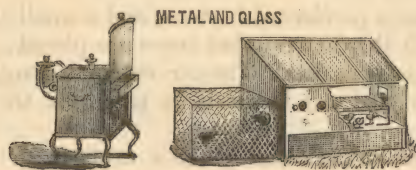


Fig. 20.

13 inches by 13½ inches, and 19½ inches in height, being neat in appearance and easy to handle. It consists, in the first place, of an outer case made of metal, which is lined with a non-conducting material to keep in the heat. The tank is saddle-shaped, only about ½ inch in thickness, and sufficiently large to fit within the cabinet. The boiler is jacketed and is connected with this tank, the circulation of the water being secured by means of return pipes. From this boiler, which, by the way, is not quite filled, two india-rubber pipes are fixed to a perforated metal pipe laid below the eggs, which secures sufficient moisture in the egg-chamber. The egg-drawer is simply a perforated metal tray of the usual pattern. This completes the Incubator, the lamp being a separate apparatus and a most ingenious one. The lamp is made to burn petroleum, but is so arranged as to be perfectly safe, and, I am assured, inodorous—which I can quite believe, as the flame will only require to be a very small one. The regulation of the heat is worked in the following manner:—The lamp is said to always burn one sized flame, and as this cannot be altered, the amount of heat applied to the boiler is ruled by the space between the flame and the boiler. The lamp is placed upon a stand, and is provided in a cleverly simple way with a lift which will raise the lamp to any position required at intervals of quarter-inches, and the inventor claims that by this means

he can sufficiently regulate the heat of the machine. Of course, a year or two ago this would have been scouted as impossible, but we now know that there is no hard and fast line, as was generally supposed.

The rearer, made of metal, stands on legs eight inches high, enclosed by glass, so that the chicks can move into the open air through the cage. The rearer is shut by a glass frame, which works on a hinge, and gives access to the interior, where the artificial mother is placed, and which is heated *outside* the rearer by a very small inodorously burning lamp.

From what I have seen of this machine, and from the accounts given by some who have worked it, I think it will be found of use to those who require a lamp Incubator. There is no intricate mechanism, no special knowledge is needed to work it, the amount of water required is small—5 pints for a 100-egg machine—and, to crown all, it is reasonable in price. Doubtless the regulation of the lamp will need care and skill, especially when sudden changes in the temperature are prevalent; but this is a matter that can easily be overcome, at any rate, if placed in a suitable room.

WATSON'S "SCOTIA" INCUBATOR.

Several improvements have recently been made in this machine, and I now give a fuller description of it.

The outer casing is of wood, and inside this casing is the tank, above which is a condenser and a packing of non-conducting material. As the steam evaporates from the water it is condensed and falls again into the tank, thereby preventing any waste of water, and also acting as a regulator. It is said that in an ordinary room this machine can be regulated to a single degree, after a little experience has been gained with it.

The egg-drawer has a perforated bottom, and a small tray for moisture at each end, and beneath the drawer other trays are placed; so that there is an abundance of moisture provided. The air enters through a space between the lamp and drawer, and can be made to pass over the eggs, or part over and part under.

MR. HENRY TOMLINSON'S INCUBATOR.

One of the oldest and best known of our poultry exhibitors has just recently brought forward an Incubator, of which Fig. 21 is an illustration.

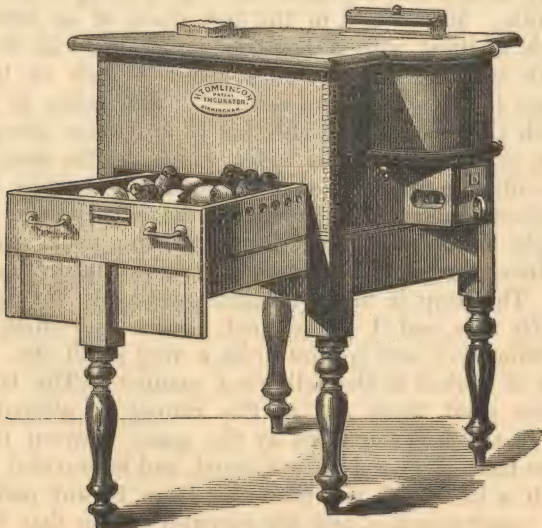


Fig. 21.

This machine is heated by means of a lamp or gas, but at the same time has one of the chief recommendations of the hydro-incubator, namely, the large body of water in the tank. By this means the machine is not so susceptible to changes of temperature as the old-fashioned regulating Incubators, in which the quantity of water in the tank was small.

The lamp needs no special description, as it is very simple, and plays a very small part in the regulation of the machine. It is only requisite to see that it is sufficiently high to give rather more than the necessary heat.

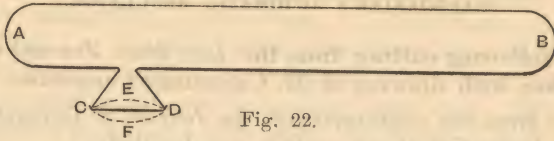


Fig. 22.

The regulating apparatus (which has been patented by Mr. Tomlinson) has nothing to do with the lamp, but works by the opening and closing of a valve, in which there are two openings $9\text{ in. by } \frac{1}{2}\text{ in.}$, keeping in the air when below and letting it out when above the temperature required. The regulator proper, Fig 22, is a glass tube (AB) placed in the egg-chamber, at the back end of which is an inverted cup, the mouth (CD) being covered with an elastic diaphragm. The tube is full of air at a temperature of 90° , and a sufficient quantity of water to well cover the elastic diaphragm when fixed in its place, thus effectually preventing any leakage of air through the diaphragm, and hermetically sealing the tube.

The action of the regulator is that as the heat rises the air in the tube expands, presses down the diaphragm (F), which acts upon a lever and opens the valve. On the other hand if the heat falls the air contracts, the diaphragm is drawn up (E), and, the lever being sufficiently weighted, the valve is closed. A screw is provided, and by means of this it is stated that the temperature can be regulated to a nicety. The advantage of having the motive power placed in the egg-chamber is very great, and with a little care in the trimming of the lamp, I do not doubt but that it will be found to work well. The chief difficulty will be when the drawer is full of live eggs coupled with a rising barometer.

In addition to the Incubator Mr. Tomlinson has introduced a "Winged Brooder" and drying-box combined (Fig. 23), which is also heated by means

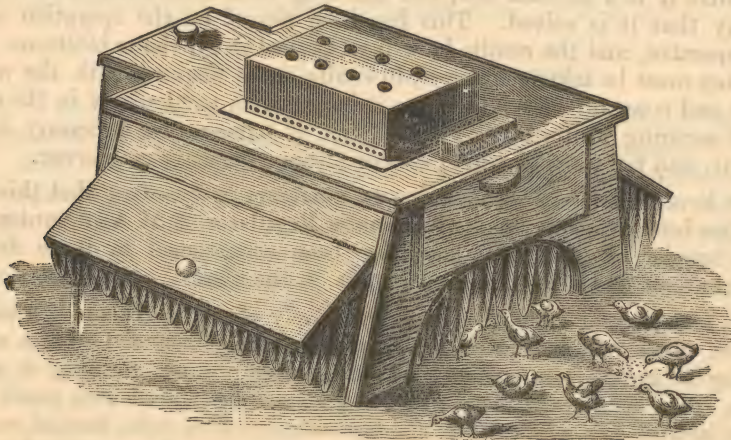


Fig. 23.

of a small lamp, but, of course, has no regulator. It has adjustable wings, which may be opened or closed in accordance with the weather, and shut up at night.

The record of work done by this machine is very good indeed, and the thanks of all interested in this subject are certainly due to Mr. Tomlinson for having given his valuable assistance to this subject, proving that it is by no means the impracticable one many think it to be.

CARBONNIER'S AUTOMATIC REGULATOR.

I give the following cutting from the *Live Stock Journal* of April 16th, (1880), together with drawing of M. Carbonnier's machine:—

“We quote from our contemporary, the *Journal d'Agriculture Pratique*, the following description of yet another new Incubator:—

‘Artificial incubation is both surer and more convenient than natural incubation, and it enables us to deal with an illimitable number of eggs at

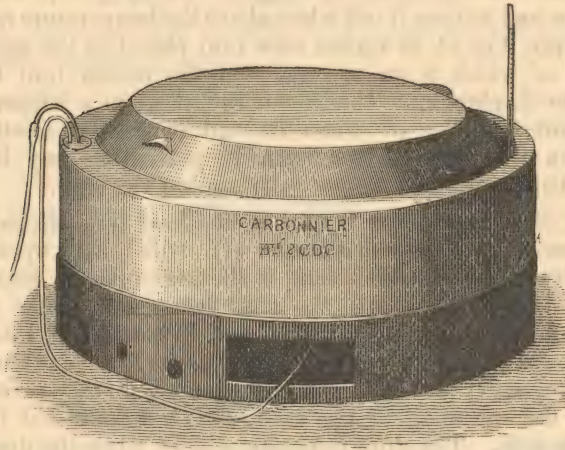


Fig 24.

any given time. The question as to the method to be followed in order to accomplish it is a delicate one, and has long been considered, and we may now say that it is solved. This has been proved by the operation of the new apparatus, and the results have been proved in all the exhibitions. One more step must be taken, however, to enable us to dispense with the watchfulness and constant care which are indispensable, particularly in the direction of securing uniformity in the degree of temperature necessary during the time, and for want of which serious disappointments may occur.

‘We have pleasure in announcing to amateurs in breeding that this difficulty has been overcome in the Automatic Regulator of M. Carbonnier—the clever breeder of fish, who has long been accustomed to these delicate investigations, and whose mind is always on the alert.

‘His new circular Incubator is made entirely of metal. Inside is a covered receiver, which will hold 150 eggs, and which is surrounded with a second covering of red copper. Underneath a double lining, forming a water-cistern, is an open space, across which goes a tube pierced with small holes for the lighted gas, which heats the *bain-marie*. This tube, carried outside, goes right up again, and enters the reservoir at the point where the

regulator is fixed. This is very ingeniously made, and we leave the description of it to the inventor.

“The principle of this regulator rests upon the non-compressibility of liquids. A small metal cylinder that will hold about a decalitre is filled with a thick liquid very easy of expansion. This cylinder is crossed by the gas-pipe, bent double, and one branch of which has an elastic bladder. The whole is kept in the water of the *bain-marie*. If the heat becomes hotter than is necessary for Incubator, the thick liquid at once expands, and the cylinder, being hermetically closed, exercises a pressure on the elastic bladder which lessens the supply of gas. In the same way the opposite effect is produced; as the temperature gets lower, the bladder swells, and the supply of gas is increased. By means of these two movements a fixed temperature is established which nothing can vary. The apparatus is delivered regulated beforehand, and set to the degree of heat necessary. It requires no care or superintendence. The only points requiring attention are that the eggs should be turned every day, and aired for about ten minutes.”

‘We may add that a small thermometer, placed opposite to the reservoir, shows the uniformity of the temperature.

‘The apparatus is used also for drying the young chickens, after which they are put in an enclosure; there they find an artificial mother made of a hot-water tank, raised upon feet, and surrounded by a small curtain, under which they run for warmth or shelter when they want to sleep.

‘This new Incubator is in full working order at M. Carbonnier’s establishment, 20, Quai du Louvre; and the chickens have appeared to us to hatch out perfectly healthy.

‘One objection only can be urged against it, and that is, that as gas is used in heating it, it can only be used in towns lighted with gas.

‘We do not doubt, however, that as the ingenious mind of the inventor has begun such a good work, he will soon discover a more general mode of application, which can be used in the country, in any cottage or farm.

A. DE BREVANS.’”

AMERICAN MACHINES.

Quite a host of machines have been produced by our American cousins, some of which are evidently the result of practical experience, and others made to sell. From a recent work by A. M. Halstead, of Rye, N.Y.—an old experimenter in this pursuit—I give notices of two of the more prominent and effective machines. The first place I will give to

HALSTEAD’S “CENTENNIAL” INCUBATOR,

which he describes as the outcome of a great many experimental machines, and goes on to say:—“The principles embodied in the present Incubator were first combined and shown at the International Exhibition at Philadelphia in 1876, from which it received its name. At that time the case of the Incubator was of wood, and the boiler, tank, and lamp only of metal.” The following year the machine was remodelled, and constructed of galvanised iron, save the heating arrangements, which are of copper.

The growth of this machine may really said to have begun in 1865, at which time the writer began his first experiments in artificial incubation, but it was not until 1878 that the “Centennial” appeared in its present form and took its hard-earned position as the standard Incubator of America, if not of the world.

As nearly one hundred of them are in use on the ostrich farms of South Africa, and fully fifty more distributed in England, Germany, Austria, Cuba, Mexico and Brazil, the title is not inappropriate.

The Incubator consists of a copper boiler and tank, the boiler encased with an outer jacket of galvanised iron, and the space between packed with mineral wool. The tank is enclosed by a case of galvanised iron, outside of which is still another case of same metal, with intervening space also packed with non-conducting material; this space is from two to three inches thick. Inside the tank is a system of tubes which bring the water from the boiler, and so distribute it that the outer edges of the tank are the hottest; the water, as it cools, is taken up by the return flues and conveyed back to the boiler, to be again heated. The heat is generated by a lamp with a kerosene burner, such as is used on a large-sized table lamp. The chimney is of metal, and passes through the water, thereby preventing any waste of heat by radiation.

The egg chamber is under the tank, the drawers so constructed that the eggs are held by parallel rods in position where placed. Under the egg-drawers is a cold water pan, to keep the bottom of the eggs cool and moist; the bottom of this water pan comes in direct contact with the outer air, thus ensuring the water from getting heated. In the egg chamber are also water vessels to provide moisture for the eggs. Over the eggs, and directly under the tank, is the thermostatic or regulating-bar. This bar is of composite character, and is the result of many years experimenting. Many of them have stood the test of three consecutive seasons, which is a very thorough test of their reliability and lasting qualities. This bar is so attached to the machine that it can be regulated from the outside, and the free end adjusted to the one-hundredth part of an inch if desired.

A ventilating flue extends from the egg-chamber through the tank, another circular hole through the tank allows the thermometer to extend down into the egg-chamber, but leaving the scale above; so the temperature of the eggs may be seen at a glance.

The regulating apparatus consists of a reel furnished with four arms, whose bent ends are caught and released alternately by the curved end of the escape lever, the lower end of which is operated by the wire point of the regulator-bar; a cord or thread wound on the reel passes over the pulley, and has a weight attached which gives the power to the reel.

Another lever is operated by two pins on the back of the reel; this lever is connected by a rod with the lamp trip.

THE "RELIANCE" INCUBATOR.

The "Reliance" Incubator was invented by James Dennis, Junr., of Providence, R.I., and patented by him in that city. It is described as a first-class machine, and is made in a thorough and workmanlike manner.

This machine consists of two cases, made of the best quality of galvanised iron, the parts of which are both riveted and soldered together. There is one inch of space between the cases, which is filled with the best non-conductor of heat yet discovered. In the upper part of the Incubator is a chamber in which is placed a soapstone radiator that is heated by means of a continuous coil of hot-water pipes. Underneath this radiator are the egg-drawers, and beneath the egg-drawers the evaporating pans are placed. The air for ventilation is taken in through holes punched in the bottom of the machine in such a manner as to materially assist in regulating the heat.

The ventilators through the top are so contrived as to thoroughly ventilate every part of the egg-drawer without exposing any of the eggs to the direct influence of the outside temperature. The machine is placed on a solid table, made of the best quality of western ash, and, for convenience in manipulating the eggs, it is furnished with a slide shelf on which to rest the drawer. The heat used is obtained from a "Florence" oil stove of a pattern made expressly for this machine. In using a soapstone radiator in preference to a tank of water, the inventor considers he has gained in several particulars, viz.:—It is very much less sensitive to changes of temperature; again, he gets a mild, soft heat, nearest like that developed from an animal body, and consequently is best adapted for developing animal life. The ventilation is perfect, as the ventilators are never closed. This is one of the simplest, if not the simplest, machines now in the market, and the inventor claims it will satisfactorily hatch all the eggs that would hatch, under the most favourable circumstances, in the natural way.

It requires very little care, as ten minutes twice each day is amply sufficient to attend to a three hundred egg machine. There is no electricity used in connection with it, and no machinery for the opening and closing of valves, so that there is nothing liable to get out of order.

MUIR'S "ROUKEN" INCUBATOR AND NURSERY.

This machine is of very recent introduction, being the invention of Mr. Walter Muir, Thornliebank, N.B., and is made for both lamps and gas, the mother being attached to the Incubator same as in Boyle's. Mr. Muir claims that with a little ordinary care the apparatus needs no automatic regulator, but he has attached one as a means of additional security. The heat is communicated to the egg-drawers and nursery by means of pipes, and an abundant provision is made for moisture, the pipes warming the nursery (which are much cooler than those for the egg-drawers) being below the water-pans, and thus a constant and regular supply is given. The front of both the egg-compartments and nursery are of glass, and thus the progress of eggs and chicks can constantly be watched. I have not had any reports as to its success in practice, and therefore am unable to speak as to its working.



CHAPTER XIII.

HEATING APPARATUS, ETC.

As will be seen upon page 20, speaking of the hydro-machine, I originally urged the adoption of a gas or lamp-stove in order to secure actually boiling water being run into the machine. I am glad to say this plan has been adopted by two firms.

Messrs. Christy and Co. have two boilers, one for gas and another for lamp, illustrations of which are now given (Figs. 25 and 26). Both these are most effective and suitable for the purpose in view.

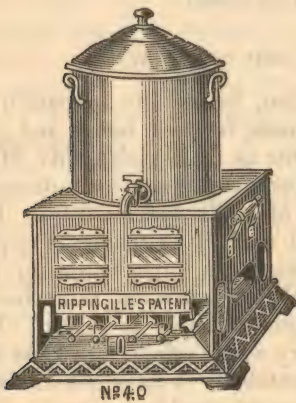


Fig 25.

RIPPINGILLE'S PATENT LAMP.



Fig 26.

GAS STOVE.

Messrs. Christy also fit to their machines, when required, a boiler (Fig. 27), so that the water in the tank can be re-heated every twelve hours, without taking it out in the usual way. This is done by means of two connecting pipes, so that a constant circulation can be kept up of the water in the upper section of the tank. Therefore, when the water is being re-heated, the body of water in this section gradually becomes as hot as if boiling water had been put in, and without all the trouble. Either one of Rippingille's patent lamps or gas can be used, the former taking sixty to ninety minutes, and the latter thirty to sixty minutes, to heat the water sufficiently. Taps are provided to prevent the flow, and consequently cooling, of the water between the times of heating, and from the experiments made this must be acknowledged a valuable improvement, for it at once does away with the great objection to Hydro-Incubators, namely, that of having to empty so large a body of water, heat as large a quantity, and fill the machine again. Of course, it necessitates the burning of lamp or gas in the room, but the injury done must be less than when these are constantly at work, for the short time either are burning is not sufficient to vitiate the atmosphere. It will always be well to have the machine so placed that the air around it can easily be purified. A small screen is provided to cover up the holes next to

the stove whilst it is burning, and thus prevent the bad air entering the egg-drawer; but I think if the ventilators were made back and front it

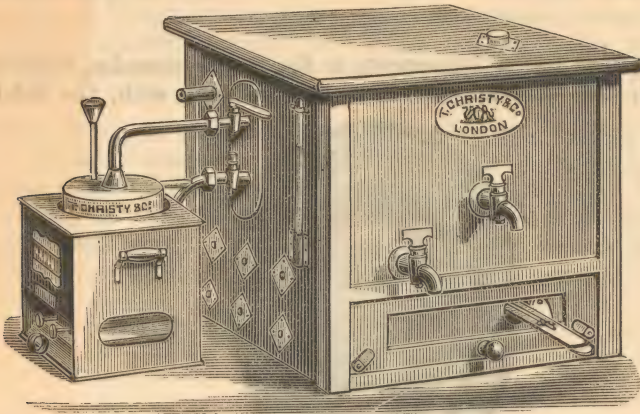


Fig. 27.

would be better. The boiler cannot be said to improve the appearance of the machine, but certainly adds to its usefulness.

Messrs. Blair and Birks have a stove of altogether different construction, called the "Gradual Heating Stove" (Fig. 28). This apparatus consists

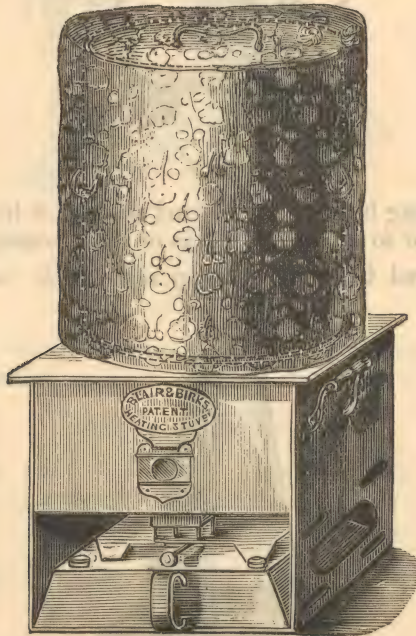


Fig. 28.

of a stove with a petroleum lamp, so arranged that only a minimum of the heat arising from the lamp can escape. Upon this is placed a boiler holding about four gallons of water, which is covered when in operation by a thin "cosy," made of felt. The makers claim that by means of this stove, water can be made to boil in twelve hours or less, without any intermediate atten-

tion ; that the stove gives off no smell, and costs only 8d. to 1s. per week. I have not personally tested it, but from its appearance think it will be of great service to those who have not facilities for boiling large quantities of water.

EGG-TESTERS.

These are most useful implements to the poultry-breeder, whether natural or artificial, and although they can be dispensed with, the old-fashioned



Fig. 29.

way of holding the egg before a candle, and shading it by the hand is by no means so effectual nor so sure as by means of an egg-tester.

Messrs. Christy and Co. have a cheap and simple tester, as shown in

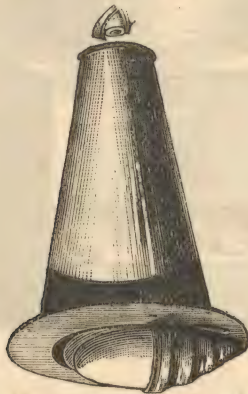


Fig. 30.

Fig. 29, being an oval rim of metal. On this is fixed a piece of cloth in which is a hole sufficiently large to cover the sides of an ordinary egg. To the whole a handle is affixed, and it is most effective and useful.

Messrs. Blair and Birks have a capital tester, of which we give an illustration (Fig. 30). This egg-tester is furnished with a magnifying lens, thereby enlarging the appearance of the egg, and bringing out more distinctly the size of the embryo within. From its telescopic construction, all possible light is excluded, except that which passes directly through the egg to the eye—an arrangement so essential to the efficiency of the egg-tester.

Mr. Alfred Perry, of Cogenhoe Farms, by Northampton, has introduced what he calls the "Acme" egg-tester, and which is certainly the best I have yet seen, and at the same time the most expensive, but well worth its cost. (See Fig. 31). It is complete with candle and powerful reflector, which, concentrating all the light upon the egg, shows if clear or fertile at the very earliest stage possible. This tester will act as a

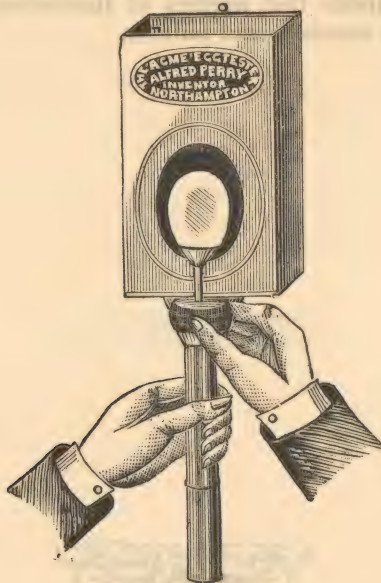


Fig. 31.

lantern, and will be found most useful to all who hatch by hens as well as those who use Incubators.

RESTS FOR EGG DRAWER.

One of the most useful improvements that could be made, and yet a much needed one, is a drawer rest which has been introduced both by Messrs. Christy and Co. and Messrs. Blair and Birks for their Incubator. This prevents all fear of the drawer falling on being lifted out, or of coming to grief where it is placed.

ADDITIONAL HINTS.

Recent information teaches us that to secure the greatest measure of success the plan of putting a few eggs into the machine every few days should not be followed, and I would suggest that where this cannot be avoided the egg drawer be divided into several compartments, so as to keep each lot separate one from another. This plan will prevent one lot of eggs chilling another.

I would also suggest that at least once a month, and once a week if it can be done, the egg drawer be taken entirely out, and that it be kept out for an hour or two in order to purify the machine. The eggs can be kept warm by means of an india-rubber hot-water bottle, a small tin tank, or even wine bottles filled with hot water. This plan will clear the Incubator of the vitiated air which will always gather there. Quicklime has been found most valuable as a means of absorbing this impure air, and a piece or two should be kept in the drawer.

In conclusion, I can only say that I shall be glad at any time to reply to queries respecting the working of Incubators, that may be addressed to me through the editor of the *Live Stock Journal*, in which paper considerable amount of attention is devoted to this question, and letters respecting the same constantly appear in its columns. In that journal letters are readily inserted, and in order that every point may be discussed as it arises, it is desirable that workers of Incubators should communicate through it both their successes and failures.



APPENDIX.

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A.

PENMAN'S MACHINE.

SIR,—In your article on my Incubator, I cannot but feel highly gratified at your very favourable remarks on the merits of "Penman's Patent Incubator," and will feel obliged by your insertion of the following reply to your very trifling objections :—

In the first place, the public are apt to be misled by your calling the material used for conveying the warm water over the eggs simply "*India-rubber*," and will be confirmed in that belief by your stating that it bags "considerably after being used for a season." The material is what is called in the India-rubber trade "Insertion," which contains a sheet of linen or some similar material between two sheets of vulcanised India-rubber, and is the same material, I am informed, of which the water-proof beds, cushions, &c., are made which are in constant use in the London and other hospitals. That it will bag, as you say, is perfectly correct; but where it has done so to act in any way injuriously it must have arisen by using more water than there is any occasion for, and any material will do the same, if subjected to more weight than it is intended to bear. In my hands—and I am at present using the same largest-made machine for the third year—I find no inconvenience from the bagging of which you speak, and it has no additional supports under it. Your suggestion for stretching wires underneath is not new, as they have been tried and abandoned for the same reason you give—namely, breaking the eggs, besides limiting the freedom you have in the trays without them.

You next suggest "to do away with the mother altogether," as being too boxed up; but you do not say what you would do in its place. I am aware that other artificial mothers detached from machines are to be had; but they are another cost, and, what is more, require another means of heating and extra time to look after them. In the machine under notice, economy of fuel and time were objects sought to be obtained. The objection you urge is easily obviated by opening the ends under the mother, and attaching, at both ends, if you like, larger runs for different sizes of birds, similar to Mr. Boyle's. This was suggested in the early prospectus. The advantage which you suggest "as to closing the sides," can also easily be obtained by any one possessing the machine without at all altering its construction; for nothing more is required to meet your suggestion than to have a cover made of some common woollen material—a piece of old carpet or drugget would do, if it be not worn into holes—and hang it over the top and sufficiently down on the sides and ends to break any draught of cold air from acting on the trays. To box in the hatching trays, as you suggest, would prevent that free circulation of fresh air which is so essential to the healthy growth of the chicks in the shell, and would only be serviceable in very cold weather. To further avoid the chilling which you mention, another plan—also a simple one—is to place a chalk, pot, or wooden egg, or even a piece of wood near the size of an egg, at each end of the row of eggs, which would effectually break any draught of cold air acting

on the eggs. I would also suggest the frequent change of position of the eggs in the tray, especially in very cold weather. There is one more subject which may be noticed, and that is the tubes in connection with the regulator, at the Incubator Tournament at Hemel Hempstead. Since September 1878, it has been found that the sensibility of the regulator is greatly increased by filling the tubes with *boiled* instead of *unboiled* cold water; and in all machines now made this plan is adopted. Since doing this to my own machine it continues for twelve hours without varying more than one degree of heat, provided the lamp has been properly trimmed and sufficient oil supplied.

THE INVENTOR OF THE "PENMAN INCUBATOR."

April 24th, 1879.

B.

CASHMORE'S INCUBATOR.

SIR,—I have tried your suggested improvements in the regulating of my Incubator, with the following results:—

No. 1. A semi-circular piece of sheet brass soldered across the tube. This appeared to me at first to be theoretically correct, but when it was fixed at work it was a complete failure, as the current of air caused the flame to fall over the bridge, and lowered the heating power of the lamp one-half when it was at the top, and could not be trusted to be kept lighted when low down. It also created a lot of smoke.

No. 2. A taper tongue, nearly the width of burner at bottom and a point at top. I could not take this one completely to the top without having a larger lamp, I therefore made it sufficiently high to touch the flame when the lamp was burning at the top. Having it fixed at mid-day, I left it with the temperature of nest 103° ; at five o'clock it was all right, temperature $103\frac{1}{2}^{\circ}$; one o'clock, 103° . Judge of my surprise to find the temperature next morning at 92° ; lamp at top; water left the float completely.

I immediately removed the tongue, and, without trimming or altering the lamp, gave forth a larger and brighter flame. I then left it without the tongue, and in about five hours the temperature had again risen to 103° , at which it kept, with but little variation, for two or three days.

It appears to me that a bridge, or tongue, that reaches to underside of burner causes the current of air to pass over the flame, and thus robs it of heating power; whereas, if there is a free passage of air under the flame, it creates a great heat when lamp is burning at the top, and immediately it begins to fall it loses power, through more air passing over the flame. The first machine I made with the present regulator was worked successfully for several weeks without a tongue. I only found need to add one when the heat of room reached 80° , the heat of lamp then being too great when at bottom of tube.

I have tried a modification of suggestion No. 2, which answers fairly; it is a taper tongue, which reaches the burner within about half-an-inch, and put the flame nearly out when a little below the middle, thus contracting the movement of the lamp.

I sincerely thank you for the suggestions, the experimenting of which has been a source of pleasure as well as profit, and I shall now adopt

suggestion No. 2, only in a modified form. I also found, through experimenting with these, that the lamp was not perfectly balanced. I have altered it in this respect, and I think now the fault in the regulating was due more to the lamp itself than to the tongue, but by altering both it has certainly made a great improvement.

C. CASHMORE.

Loughboro', Nov. 3rd, 1879.

C.

MESSRS. CHRISTY'S INCUBATOR.

To the Editor of the Live Stock Journal.

Ayr, 23rd April, 1879.

SIR,—About a month ago, one of Messrs. Christy's Egg Incubators was forwarded to Ayr to be tested under the auspices of the County Agricultural Association. It was handed over to Mr. Caldwell, Steward of the Poultry Section, who has forwarded the following report on its merits. I think I ought to say that the Incubator, in my opinion, received every justice in its testing at Mr. Caldwell's hands.—Your obedient servant,

WILLIAM ROBERTSON.

MR. CALDWELL'S REPORT.

"12, Midton Road, Ayr,

"19th April, 1879.

"The Hydro-Incubator entered by Messrs. T. Christy & Co., London, for exhibition at the ensuing show of the Ayrshire Agricultural Association, to be held in Ayr on the 29th and 30th days of April, 1879, has been, in accordance with the Association's request, fully tested by me in company with the gentlemen whose certificate is appended to this report. The subjoined table will show the various temperatures obtained during the trial. Before giving an explanation of the mode the machine was worked, I beg to state that the Hydro-Incubator was the first Incubator I have seen, and that I was entirely ignorant of its working until the machine was put into my hands for testing. I very carefully studied the instructions sent out by Messrs. Christy for the working of the Incubator, and during the trial I have tried to follow them as close as possible. The Incubator was filled up with hot water, which was emptied out at the end of 12 hours. It was again filled, and every 12 hours a few gallons of water put in. In presence of a number of gentlemen, 64 marked eggs were placed in the drawer of the Incubator. The testing of the eggs to find out the fertile from the non-fertile, and the hatching of the chickens, were done in presence of the same gentlemen. The following is the result obtained:—

No. of eggs put in Incubator.....	64
No. found non-fertile	25
	—
	39
No. hatched out	28
No. of chickens dead in shell, fully matured, but too weak to break shell	7
No. of chickens apparently a day or two dead ...	4
	—
	39

Being a percentage hatched out of 71·31.

During the course of the trial the weather was extremely variable—hard frost, snow, rain, and sometimes fine weather—and although the machine was in a room in which a fire was kept constantly burning night and day, a glance at the temperature obtained will show the effect of the weather. I had a tin kettle constructed that would hold and boil 4 gallons of water, and I experienced no difficulty in getting the boiling water introduced into the Incubator at 212 degs. F., and after a little practice in being able to determine the quantities to be put in to keep the temperature in the drawers at the requisite heat. The time taken in drawing off the water, turning the eggs, and pouring in the hot water at 8 a.m., averaged from 15 to 20 minutes, and at 8 p.m., 10 to 15 minutes. The machine is easy to work, and, unless in cold weather, when it is judicious to add a few quarts of hot water between the 12 hours, does not take up your time more than 25 to 35 minutes per day. The chickens were all put under the hydro-rearing mother, where they seem to be quite at home, and perfectly able to look after their creature comforts.

“DAVID CALDWELL.”

Date.	Temperature of of Atmosphere in Room.		Heat of Water put into Incubator ought to be 212°.		Heat of Water that came out of Incubator.		Heat in the Drawer.	
	Morn.	Night.	Morn.	Night.	Morn.	Night.	Morn.	Night.
28th March	52	54	212	212	146	150	100 $\frac{1}{2}$	102
29th "	54	58	212	212	147	154	100	103
30th "	57	58	212	212	152	151	103	103
31st "	58	59	212	212	150	146	105	104
1st April	58	59	212	212	142	141	102	101 $\frac{1}{2}$
2nd "	59	59	212	212	141	148	99	101
3rd "	59	59	212	212	146	146	102	103
4th "	59	60	212	212	144	146	102	102 $\frac{1}{2}$
5th "	60	61	212	212	146	148	103 $\frac{1}{2}$	104
6th "	60	60	212	212	144	142	103 $\frac{1}{2}$	103
7th "	59	61	212	212	140	144	102	103
8th "	61	60	212	212	140	144	102	103 $\frac{1}{2}$
9th "	60	60	212	212	141	140	103	104
10th "	58	58	212	212	136	138	101 $\frac{1}{2}$	102
11th "	57	59	212	212	141	143	102 $\frac{1}{2}$	105
12th "	59	58	212	212	137	136	104	104
13th "	56	56	212	212	134	134	103	102
14th "	56	56	212	212	134	134	102	104
15th "	56	56	212	212	136	136	101	103
16th "	56	59	212	212	30	132	102	102
17th "	59	59	212	212	134	136	101	100

*Report by Committee associated with Mr. Caldwell in the testing
of the Incubator above referred to:—*

We, the undersigned, were present when the eggs were placed in the Incubator above referred to, when they were tested, and when the chickens were hatched, and are perfectly satisfied at once with the fairness of the test, the simplicity and excellence of the machine, and its capability for discharging the functions assigned to it.

DAVID YOUNG, 1, Queen's Terrace.

R. G. WALKER, The Old Manse.

ROBT. SCOULAR, Dutch Mills.

WM. McCracken, Kyle Union.

WM. ROBERTSON, Buckingham Terrace.

D. HATCHING RESULTS.

TO THE EDITOR OF *The Live Stock Journal*.

SIR,—As promised in a former letter, I send you hatching results for the season. The eggs (except the La Bresse) were, down to April the 24th, set from day to day as laid, being kept for the first 8 days in a Christy 50-egg Clucker with all the ventilators closed, and for the rest of the period of incubation in a Christy 90-egg Hydro-Incubator with all the ventilators open. The eggs set were mostly Dark Brahmas, but there were about 35 Brown Leghorns (chiefly set in January), 23 La Bresse, and 20 Courtes Pattes. The Brown Leghorns did best of any, and the Brahmas next; but then it is only fair to mention that the La Bresse had a long railway and sea journey, and that so few of the Courtes Pattes were fertile that there was no great opportunity of judging as to them. The lot of 50 set on May 3rd were kept in the Cluckers throughout, the ventilators being opened after the eighth day. These were a promiscuous lot, consisting chiefly of Leghorns and cross breeds. I wished to test the merits of the Clucker, which requires very little water (I used on the average a gallon every 8 hours), and as will be seen it came out of the trial well.

I may mention that by far the worst period during my season was the month of March (the first fortnight of which was specially disastrous), and the early part of April. I attribute that partly to the prevalence of east winds during that period, and partly to the fact that, owing to the Incubator being placed within range of the kitchen fire, the front part of the egg-drawer was sometimes as much as five degrees higher than the back. This was not discovered at first, and did not affect the earlier months, when the drawer was comparatively empty, and the eggs were consequently more in one part of the drawer. As to the effect of the east winds, I heard complaints on all sides that chicks set under hens came nearly to maturity in the shells, but did not seem to have strength to hatch out. I set two hens on March 31st, with twenty-two dark Brahma eggs; of these four were removed clear and two addled, thus leaving sixteen fertile eggs. Of these nine were dead in shell, and seven hatched out alive. This gives only 43·74 per cent. as the result of the hatching under the hens, which is somewhat inferior to the average Incubator results at the same period. I am uncertain as to the correctness of counting addled eggs as unfertile. When examined, unbroken, on about the eighth day with a strong light, they in general showed a circular streak of blood, which was immovable. I incline to think that these eggs must have been imperfectly fertilised, and that the Incubator was in no way responsible for their failure to hatch. The following is a table of the season's results, arranged as far as possible so as to show each month separately:—

Date when set.	Number sent.	Removed clear.	Removed addled.	Fertile.	Dead in shell.	Hatched.	Date due to hatch.	Percentage of fertile eggs hatched.
Dec. 16 to Jan. 10 ...	52	20	3	29	6	23	Jan. 6 to 31	79·31
Jan. 11 to Feb. 8 ...	72	28	7	37	8	29	Feb. 1 to 29	78·37
Feb. 9 to Mar. 10 ...	77	33	6	38	16	22	Mar. 1 to 31	57·89
Mar. 10 to Apr. 9 ...	167	44	15	108	45	63	Apr. 1 to 31	58·33
Apr. 10 to Apr. 24 ...	72	22	7	43	18	25	May 1 to 15	58·13
May 3	50	6	2	42	7	35	May 24	83·33
Dec. 13 to May 3 ...	490	153	40	297	100	197	Jan. 6 to My. 24	66·32

This shows an advance of over 16 per cent. on last season's results, when I used the Hydro-Incubator alone; and, so far as any argument can be fairly drawn from so limited an experiment, goes to prove that there is an advantage gained by keeping the eggs for the first eight or nine days in a close moist atmosphere.

ALEX. COMYNS.

London, June 19th, 1880.



Christy's Hydro-Incubators.

GOLD MEDAL AND £25 PRIZE AT HEMEL HEMPSTEAD.

These can be fitted with an outside Circulating Boiler, doing away with the necessity of replenishing night and morning with boiling water, and requiring only, to work a 90 Egg Hydro-Incubator, a consumption of gas for 20 minutes, or of oil for 1 hour, night and morning.

OVER 500 REFERENCES.

Mr. WEMYSS-COLCHESTER, of Mitcheldean, Gloucestershire, writes:—"Our Hydro-Incubator will be empty for the first time for months, and I can say that it has worked most admirably."

Mrs. PAYNTER-EDWARDS, of Thornbury, writes:—"That her Hydro-Incubator has been most satisfactory, all the fertile eggs being hatched, and at her last sitting, 54 chicks from 63 eggs, all, with the exception of some accidents, doing well."

In Ireland our Hydro-Incubators are being successfully used by Miss BENCE JONES, of Clonakilty, Miss IDA BRINKLEY, of Kingstown, A. E. COMYNS, Esq., Secretary of the Poultry Club, &c. &c. &c.

Hydro-Incubation, in Theory and Practice.

A Guide to Commercial Poultry Farming. Illustrated. 104 pages, post free, 1s. 2d.

NEW PRICES.

					With Outside Boiler.
50 Egg Hydro-Incubator	...	...	...	£3 10 0	£5 0 0
90 "	"	(Gold Medal Pattern)		£4 10 0	£6 0 0
90 "	"	(Cheap Pattern)	...	£2 10 0	£4 0 0

DRYING BOXES, REARERS, &c., ALL SIZES.

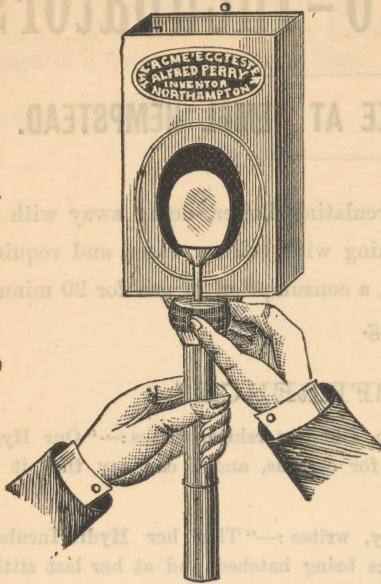
FULL PRICE LISTS ON APPLICATION.

THOS. CHRISTY & CO.,

155, FENCHURCH STREET, LONDON.

The "ACME" EGG TESTER

With Strong Reflector, 5s. each.



Candles to fit, 9d. per Packet.

FOR testing Eggs of all kinds of Poultry, Pigeons, and Game. Each Egg-Tester is sent out with a slide to take an ordinary Hen's egg. Extra slides, one for Turkeys and Geese, another for Bantams, Pheasants, Partridges, and Pigeons, may be had price 1s. 9d. each; or Egg-tester, three slides, and packet of candles, 9s. complete.

CAN BE USED AS A LAMP WHEN NOT TESTING EGGS.

Eggs supplied for hatching from Light and Dark Brahmas, Buff and Partridge Cochins, Houdans, Golden-pencilled and Black Hamburgs; White-crested and Silver-spangled Polish, Black-Red, and Pile Game, Sebright and Game Bantams; Pekin, Rouen, Aylesbury, and other Ducks, Pheasants, &c. &c.

CHICKENS AND ADULT FOWLS ALWAYS ON SALE.

Terms, &c., on receipt of Stamped Envelope.

ALFRED PERRY,

THE MANOR POULTRY YARDS,

COGENHOE, near NORTHAMPTON.

EGGS FROM PRIZE POULTRY.

Messrs. R. R. FOWLER & Co.,

PREBENDAL FARM, AYLESBURY,

WILL have EGGS to dispose of from their CELEBRATED STOCK during the present Season, all AT 16s. PER DOZEN, including Packages, as under:—

Dorkings—Coloured.

Ditto Silver.

Ditto Grey.

Ditto White.

Brahmas—Dark.

Ditto Light.

Cochins—Partridge.

Ditto Buff.

Ditto White.

Ditto Black.

Game—Black Red.

Ditto Duckwing.

Ditto Indian.

Spanish.

Creve Coeurs.

Houdans.

Leghorns—White.

Ditto Brown.

Ditto Cuckoo.

Ditto Black.

Plymouth Rocks.

Andalusians.

Black Minorcas.

Japanese Silkies.

Red Faced Silkies.

Ducks—Aylesbury.

Ditto Rouen.

Ditto Pekin.

Ditto East Indian.

Ditto Black Cayuga.

Birds from most of the above—and also Cambridgeshire Turkeys—Toulouse and White Embden Geese—may be had during the greater part of the year.

It is unnecessary to mention here the Prizes won by the various breeds above named, as the Prebendal Farm Stock has carried off Silver Cups and Leading Honours at every Great Exhibition in the Kingdom, from the earliest days of Poultry Shows till now; but a DESCRIPTIVE CATALOGUE, giving Further Information, and Hints on Rearing and Management, will be sent free on application. [10]

Please Note Address—"PREBENDAL FARM," as there are others of the same name near AYLESBURY.

THE "RELIANCE"

INCUBATORS AND REARERS,

FOR

POULTRY, DUCKS, GAME, &c.

LIST OF PRICES.

Incubator for 90 eggs		£2 17 6
<i>If fitted with Improved Egg Drawer, 10s. extra.</i>		
Rearing Mother, with Adjustable Screw Legs		£1 12 6
Open-Air Rearer, with Mother and Glass Run complete	£3 12 6	
Patent Gradual Heating Stove, complete with Boiler,	} £1 16 6	
"Cosy," &c.		

All other necessary Appliances for successful Artificial Hatching and Rearing.

ILLUSTRATED PRICE LISTS POST FREE.

SCORES OF TESTIMONIALS.

Messrs. R. R. FOWLER & Co., *Prebendal Farm, Aylesbury, July 22nd, 1880.*

"We consider your Incubator and other appliances far away the best, simplest, and most economical Machines for the purpose we have seen out yet. And several persons, both at home and abroad, who partly on the strength of our recommendation purchased sets of your Appliances, have written us expressing their satisfaction and pleasure at the success they have had in their use."

H. TOMLINSON, Esq., *Gravelly Hill, Birmingham, May 13th, 1880.*

"I have pleasure in informing you that the Incubator I had from you this season has worked entirely to my satisfaction, and has hatched me a *much larger percentage of chickens than my sitting hens*, and your Open Air Rearer and Mother have proved of great service during the cutting east winds we have had the last month. My chickens are quite as strong or stronger than those reared under hens."

ALFRED PERRY, Esq., *Manor Poultry Yards, Cogenhoe, near Northampton, Aug. 3rd, 1880.*

"Your two Incubators have hatched out considerably more chickens than I could have expected from sitting hens, and the last batch of partridge's eggs put in Incubator yielded 100 per cent. The Open Air Rearer has given me equal satisfaction."

Rev. W. SERJEANTSON, *Acton Burnell Rectory, Shrewsbury, April 18th, 1880.*

"I am delighted with the Open Air Rearer. If you have another one in stock send it off at once."

Mrs. S. NIX, *Tilgate, Crawley, Sussex, May 7th, 1880.*

"I have found your Out-door Rearer of great service with my early broods, and my poultry man tells me he prefers your Indoor Rearer to any he has yet tried."

Mrs. C. GORDON, *Pacombe, Sidford, near Sidmouth, Devon, March 12th, 1880.*

"I am glad to be able to tell you that so far I have been completely successful with the Rearing Mothers. My chickens are thriving wonderfully, and I have not had a single case of illness amongst them. The Incubator and Gradual Heating Stove are working perfectly."

LORD PARKER, *Marchington, Uttoxeter, April 24th, 1880.*

"I am much pleased with the two Gradual Heating Stoves I had from you. They are the best stoves for the purpose, burning very little oil, and requiring no attention for twelve hours."

G. M. RODGER, Esq., *Arden House, Altrincham, May 20th, 1880.*

"Your Gradual Heating Stove has given me great satisfaction. Without it I do not see how a lady could manage an Incubator by herself; with it, however, this is easily done, as all that is required is to turn the tap and allow the water to run into the filler of the machine."

Barton House, Dulverton, June 22nd, 1880.

"Major Morant is exceedingly pleased with the Gradual Heating Stove, and he will probably require one or two more."

BLAIR & BIRKS,

HEATH POULTRY FARM,

Near LEIGHTON BUZZARD, BEDS.

YOUNG FOWLS, PHEASANTS, PARTRIDGES, &c

Thousands of these Birds may be brought to maturity by the timely use of

LEACH'S

"GAPES, ROUP, & CRAMP PREVENTIVE"

AND

General Health Preservative Solution.

The most formidable disease from which young Fowls, Pheasants, and Partridges suffer, is that known by the name of the "Gapes," so termed from the frequent gasping effort of the birds to inhale a mouthful of air. Turkeys are equally liable to be affected by it.

Dissection has proved that the latent cause of this malady is a minute worm of the genus *fasciola*, which found adhering to the internal part of the windpipe or trachea.

"Cramp," or "Leg Complaint," as it is frequently called, is always caused either by exhaustion through being affected with the "Gapes," or from cold and damp weather.

Various remedies have been tried to cure birds after they are affected, but all with very little success.

The above preparation is to prevent their ever having either of these Complaints, but if they should have them, any disease, it is of such a tonic and stimulating nature, that in nine cases out of ten it will give them strength sufficient to overcome their ills. The flattering accounts of the benefit derived from its use, as also the increased sale, induces the Proprietors to use this means to make it more generally known.

THE FOLLOWING TESTIMONIALS SPEAK VOLUMES:—

Found Hill, Bletchingly, Surrey,
February 21st, 1871.

Sir,—At the recommendation of a friend, I last year gave your "GAPES AND CRAMP PREVENTIVE SOLUTION" a trial, having had such bad luck with young Pheasants for several years since. Unless I had proved it myself, I could not credit the good effects of it, not only as regards the "GAPES," but in what is known as "Leg Complaint" (Cramp), both of which pests I was entirely freed from, and brought a fine lot of birds to perfection. You ought to make the Preparation more known, for there would be thousands more birds if it was generally used. JOHN SHERLOCK, Gamekeeper.

To Mr. Leach, Crawley.

Genoch, Stranraer, North Britain,
Sept. 21st, 1868.

Sir,—I have pleasure in saying that the liquid with which you supplied me has given great satisfaction, and been quite as successful in the rearing of young birds as much more expensive preparations.—Your most obedient Servant,
ALEX. NEEL-CAIRD.

To Mr. Leach.

Hurst Land, Horley, Surrey,
15th March, 1880.

Dear Sir,—I am pleased to give my strong testimony to the good effects of your "PREVENTIVE SOLUTION" for Gapes, &c., in Game and Domestic Fowls. I have used it the last twelve seasons, and never was so fortunate in rearing birds. For weakly backward broods it is invaluable; and I am sure if you make it known about the country it will be used almost everywhere.—I am, yours obediently,
JAMES WOODMAN, Gamekeeper.

To Mr. Leach.

P.S.—You may refer any one you like to me.

N.B.—Where Laying Hens, &c., are obliged to be kept in a small yard or aviary, an occasional use of this Preparation will be found of great benefit, in keeping them in a strong healthy state.

IT IS SIMPLE, EFFECTUAL, AND INEXPENSIVE

THE ABOVE IS MADE ONLY BY

LEACH & WEEDON,
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IN BOTTLES AT 2s. 6d. & 5s. EACH (A SAVING IN TAKING THE LARGER SIZE)

And sold wholesale by them and Messrs. BARCLAY & SONS, 95, Farringdon Street; and retail of all Chemists; direct from the Manufacturers, Carriage Paid, to any Railway Station on the L. B. & S. C. Rail, or to London or other lines on receipt of P.O.O. or Stamps for 3s. or 5s. 6d.

LEACH'S CRAWLEY AND HORSHAM HUNT SAUCE

A most delicious and wholesome Relish with Cold Meat, Chops, Steaks, Game, Fish, &c.; or as a Flavouring to Gravies, Soups, or Made Dishes.

The success attending the introduction of the above induces the Proprietors to bring more prominently before the Public. It adds relish to the choicest viands, renders the plainest food delicious, creates appetite, and assists digestion.

The following TESTIMONIAL was sent to Mr. Leach (unsolicited) by ROBERT LODER, Esq., M.P.
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"I can safely say that I like it better than any other Sauce, and that I shall have great pleasure and confidence in recommending it to my friends."

Sold in $\frac{1}{4}$ -pints, 6d., and $\frac{1}{2}$ -pints, 1s. (imperial measure).

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